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By William J. Coulter

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International Conservation of Mineral Resources

By Frank H. Probert

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Applications of the Petrographic Microscope

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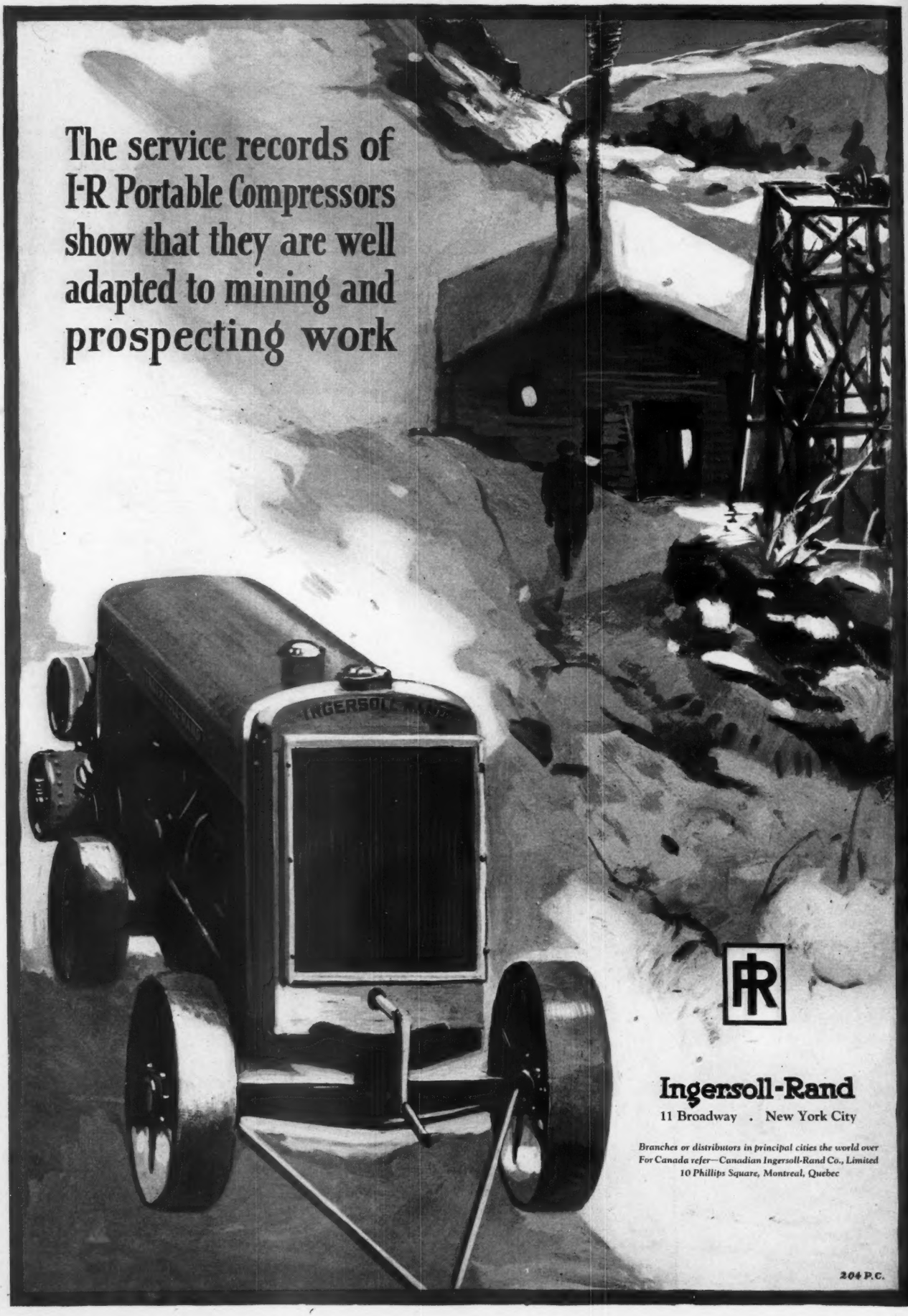
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New York, March 23, 1929

The Most Important Event of the Week

E.&M.J. is more than a technical magazine: it is the newspaper of the industries that it serves. This week the most interesting news event was the rapid advance in copper prices, with reports of a flat jump of one cent in prices in a single day, a record peace-time advance. In one day, also, lead prices advanced from £24 1s. 3d. to £29 15s. in London. Published in New York, the leading metal market of the world, *E.&M.J.* can give prompt and accurate reports of conditions in this field. The New York *Times* and other metropolitan newspapers rely upon us for this news service.

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A Newer Concept of Technical Co-operation

THE WISDOM of the American policy of engineering co-operation through dissemination of technical information is becoming more and more appreciated, not only in America but in the rest of the world as well. Information has been freely released through the technical press, through professional societies, and by freedom of intercourse between the technicians of the operating companies. The companies that have been most liberal and progressive in this respect have profited most, for they have had opened to them in a larger degree the experience of others. As the younger generation acquires increasing influence, the idea is spreading to other parts of the world, and extensions of the principle are evident.

A particular development of this kind is the practice of granting leaves of absence to specialist employees for the purpose of assisting other companies, particularly in foreign countries, to solve problems in the employee's special field. A few instances of this tendency may serve to emphasize the liberal opportunities at present afforded technical employees of American mining companies:

E. E. Barker, Utah Copper's competent engineer, was granted a leave of absence in 1927 to visit and report on possibilities of large-scale operation at the Mount Morgan mine, in Australia. Soon after Mr. Barker's completion of this assignment he spent several months in studying the open-pit mining problems at the Thetford, Quebec, asbestos mines for Johns-Manville, and he is now back at Utah on the problem of stepping up Utah Copper's daily output to 100,000 tons per day, according to a recent report. His experiences afield will, of course, help him. W. C. Page, of International Smelting, to whom J. O. Elton has given credit for the actual development of the selective flotation process in Utah to its present position of importance, recently went on leave to work out the flotation problems of Roan Antelope. R. S. Handy, of Bunker Hill & Sullivan, recently returned to Kellogg from Bolivia, where he was engaged in assisting Patiño Mines & Enterprises to modernize its metallurgical plant. C. H. Benedict, father of the ammonia-leaching process at Calumet & Hecla, and his able assistant H. C. Kenny, spent some time in assisting the Bwana M'Kubwa company with its difficult leaching problem in Northern Rhodesia. A. B. Young, of International Smelting, was granted a leave of absence to assist Cerro de Pasco in the solution of smelter smoke problems in Peru, similar to work he had done in Utah. H. W. Aldrich, of Inspiration, has given Andes Copper the benefit of his expert knowledge of copper leaching. O. E. Keough, another of International Smelting's selective-flotation specialists, recently spent some time at Bethlehem Steel's Lebanon concentrator. Lucien Eaton, of Cleveland-Cliffs Iron, visited and developed a method of mining for one of the Russian iron mines of Stuart, James & Cook not long ago. This lists only a few of the better-known examples of the tendency toward a complete realization of technical co-operation.

The willingness of operators to permit their technical specialists to spend time with other companies is a relatively recent development. Not so long ago, a company engineer had virtually no opportunity for broadening his experience in this way—each change he might make, of necessity, had to be an entirely new connection, with a complete severing of old ties. The current extension of liberal technical co-operation is an excellent indication of the progressive attitude adopted by well-managed American mining companies. Not only are the knowledge and reputation of the individual enhanced, but the company profits also by the broadened outlook and the new ideas that the engineer has gained, and is in position to apply, when he returns to his regular position.

Pewter Comes Into Its Own Again for Household Purposes

AT THE same time that numerous new alloys with remarkable qualities are being utilized in industry, another, which has been known for centuries, is enjoying a revival in the home. This alloy is pewter. Current popularity of pewter ware may be attributed to the interest brought to it by the collectors of old articles fashioned in the metal. These antiquarians, who have increased greatly in number during the last few years, while seeking out pieces of the ware bearing the "touch" or mark of the maker, have not only removed practically all such antiques from the market, but have created a demand for the ware that has led to the introduction on the market of modern pewter.

The extent to which pewter has served mankind in the past is not commonly known, although the history of the alloy is particularly interesting. Roman pewter has been disinterred at various places in England and elsewhere; but not until the Middle Ages, ten centuries later than the supposed date of the Roman pewter found in Britain, are reliable references to the alloy available. The metal first appears in history in 1074, when a synod at Rouen permitted its use as a substitute for gold and silver in Church vessels. Adaptation of pewter for domestic purposes began apparently with the caldrons employed for boiling meat at the coronation of Edward I of England in 1274. During the following century the manufacture of pewter ware increased rapidly,

spreading to almost all centers of western Europe. Confined at first to the more wealthy classes, its use became more extensive as the years passed. Pewter was in general use in the American colonies for 150 years from the middle of the seventeenth century, in the kitchens of the wealthy and as the only form of tableware owned by the mass of the people. This is the pewter sought now by most of the collectors. The vogue of pewter then declined steadily, the growing cheapness of glass and chinaware, and the adoption of brighter metals for household articles, finally causing it to become unpopular. With few exceptions, manufacture ceased.

Today, however, pewter is again much in demand. Advertisements of dealers in the ware appear almost daily in the newspapers and other publications serving the home. In one such notice, a pewter coffee pot is described in the following terms: "A new fashion for the breakfast table—and a lovely one. Coffee pot with beautifully simple lines and dull gleaming surface that are the charm of modern pewter." Composition of the ware is said to vary slightly with different manufacturers, but in general it is 91 per cent tin, 6½ per cent antimony, and 2½ per cent copper. An estimate of the consumption of these metals for the manufacture of pewter this year is impossible, owing to the inability to gage the extent to which public demand will grow. The vogue, however, merits encouragement, as there is little likelihood that pewter ware will replace silver table service or the utensils used in the kitchen. It serves an intermediate purpose, and may be included among the many necessary luxuries that prevail in the civilization of today, and to which mining, like the other industries, is indebted for a large portion of its current prosperous state.

Psychological Effect of Co-ordinated Opinion

BASED on the assumption that the trend of business will lie in a direction predicted by the majority of leading business men, a unique type of research service has been formulated and put into operation by the Bureau of Business Standards, subsidiary to *The Magazine of Business,* the editor of which believes that as business men think so will they act. Their thinking is sensitive to outside influence, however, being quickly affected by factors such as unfilled orders, inquiries, sales, collections, and the status of the money market. The task is therefore to obtain the aggregate opinion of business men, and for this purpose an exhaustive survey is made monthly, covering over 20,000 leading executives. Thus is ascertained one of the three factors that determine the status of future business—the psychological factor, or what business thinks. Of the other two main factors, "present conditions" are determined by statistical data, and "unforeseen events" cannot be prophesied or their effects determined in advance.

The monthly report of the Bureau is a most interesting document, covering fourteen sections of the United States, as well as Canada. The information received from the business executives enables the economist in charge to give actual figures on the status of business compared with the same period last year, and the volume of business expected for the ninety days ahead, also on a comparative basis. In addition, the economic status of each district is given, with respect to the most favorable and the least favorable factors. The report for February 15, for example, indicates a generally healthy condition throughout the United States. In Canada, be it noted, the status of current business is given as 10 per cent above what it was a year ago, and executives are of the opinion that this condition will persist throughout the next ninety days. The most favorable factor in both the United States and Canada is "General Confidence"; the most unfavorable one, "Stock Market."

Analyses such as these will take much of the element of chance from industrial operations. Mining is dependent for its prosperity on the general economic status of the Americas in particular. *Engineering and Mining Journal* sees opportunity for an extended survey of this character, to include a definite recognition of trends and opportunities in the metal-mining industries.

International Nickel's New Bonanza

WITHOUT DOUBTING for a minute that the International Nickel Company has uncovered a bonanza in developing its Frood mine, in northern Ontario, the fact remains that some of the estimates of the value of the ore proved in the deposit seem exaggerated. *The Annalist,* for example, using figures pieced together by *The Financial Times,* stated in a recent issue that the proved and indicated resources of the International-Mond enterprise amount to $9,640,000,000. This puts quite in the shade the stock-market valuation of the shares, which in itself is no mean total, being not far below a billion dollars.

This is the way the valuation works out, according to the story mentioned: Developed ore at the Frood mine is said to be about 120,000,000 tons. Average assays over a length of 400 ft. and a width of 150 ft. at the 2,700 level are said to be 4.5 per cent copper, 4.2 per cent nickel, and 5 grams of platinum metals per ton. This gives a gross value per ton of $64, taking the platinum at $90, copper at 16c., and nickel at 40c. Multiplying 64 by 120,000,000 gives $7,680,000,000, and presumably the other two billion dollars of valuation is inherent in the other properties of the company.

This reasoning has several faults. To begin with, so far as known the 120,000,000 tons represents the entire orebody from the deepest levels developed up to the surface, and much of this tonnage is nothing like so rich as indicated. It does not seem accurate to take the assay on the 2,700 level, where the ore is admittedly rich, and apply it to the entire orebody. Also, the values used for platinum and nickel are too high. Platinum is not worth more than about $65, though the presence of rarer metals of the platinum group might bring the valuation up; and most of the nickel sold is billed at around 31 or 32c. Copper, of course, is now higher than 16c. Furthermore, if this immense deposit should throw nickel and platinum on the market at anything like the rate at which this indicates it to be capable, the price would drop fast. Finally, the value given is, of course, a gross value and entirely neglects the cost of metal reduction.

The fact remains, however, that the Frood mine is

one of the richest orebodies ever discovered, and time may prove it to be *the* richest. Development, according to the annual report just issued, has not gone far enough to indicate exact tonnages or average assays, but some indication of the metal content is given as follows: On the 1,200-foot level, 100 feet of ore averaged 1.77 per cent nickel and 2.61 per cent copper; on the 1,600, 48 feet of ore averaged 2.15 nickel and 2.90 copper; on the 2,000, 39 feet of ore ran 1.93 nickel and 2.09 copper; on the 2,400, 64 feet of ore crosscut showed 1.5 nickel and 3.6 copper; and on the 2,800-foot level, 139 feet of ore averaged 2.66 per cent nickel and 12.14 per cent copper. These last figures are certainly intriguing as to the possibilities at even greater depths. Nothing is said as to the content of platinum metals except that the content is higher than in the Creighton mine ore heretofore smelted. This is supposed to have been approximately 0.02 troy ounce, or 0.6 gram, per ton.

An interesting circumstance is that this bonanza orebody was referred to in the annual reports of the company as far back as three years ago, when Mr. Stanley stated: "Diamond drilling at the Frood mine, which is the largest of the company's ore deposits, has proved the existence of an extensive tonnage of high-grade ore at depth. . . . This development is particularly encouraging." Encouraging to the company officials, perhaps, but not, at that time particularly so to investors, for the stock sold at only $35 a share, compared with $435 on the same basis three years later.

Survival of the Weaker Secured by Mines Consolidation

IN A RECENT ISSUE was discussed the suggestion that two of the deepest mines on the Witwatersrand—Village Deep and City Deep—be consolidated. City Deep is suffering from a decline in ore grade. Village Deep, on the other hand, recently re-entered the dividend-paying class. Its neighbor is "in the red," but it has the advantage of possessing a larger reserve of commercial ore than does Village Deep. United—they may both stand. Divided—one will certainly fall.

Combination, followed by unification of control and management, may afford the best solution of a broad industrial problem. Seldom, however, is the more prosperous partner willing to saddle his enterprise with the incubus of a venture of questionable outcome. Not many years ago we commented on the steps being then taken to consider ways and means whereby the threatened closure of the East Rand Proprietary mines might be avoided. A government committee suggested that arrangements should be made between the East Rand and the Cinderella, which were neighbors, to operate the two properties as one concern. The advice sounded arbitrary, but it was given in the interests of South African mining and of the industry as a whole. The question was raised at the time: Is it against common sense to suggest that a government is justified, morally or constitutionally, in preventing the decay of an industry by insisting on a consolidation of the prosperous with the needy? Ore ceases to be ore when it cannot be extracted and treated at a profit; but if a mine possessing such material be situated next to one with ore of such a grade that its prosperity for many years is assured, then the waste on the one side of the boundary line assumes the prospective character of ore. This being so, is it not reasonable for a government to conserve mineral resources by insisting that all ore treatable at a profit shall be so treated, even if this be possible only by a consolidation between two or more companies? The suggestion, as we have averred before, opens interesting possibilities, for many deposits would assume a vastly greater economic importance if such an average could be made. The discussion draws attention to the advantages of large-scale operation, unified control, and cheaper methods of mining and beneficiation.

The Growth of Air Travel and the Future

ADVERTISEMENTS of offerings of shares in several aviation projects recently appeared in the same issue of a prominent New York daily—evidence of a renewed attempt to capitalize the existing widespread interest in the possibilities of aerial transportation. Not every venture in this most up-to-date field of enterprise will prove successful, one may readily take for granted. Here as elsewhere will be exemplified the truth of the adage that "all life is selection," and those who profit by investing or by taking flyers in aviation stocks will for the most part be those who select wisely in the first place and then are blessed by Lady Luck—a formula that invariably brings success.

Interest in the financial possibilities of aviation enterprises is justified. Mankind appears on the threshold of the conquest of the air, if such conquest has not already been achieved. One individual there is, indeed, who is thoroughly convinced that the air has been fully conquered—the Canadian prospector. Air travel to him is fast becoming the accepted means of getting from point to point. Who would spend days and even weeks in arduous unpleasant toiling through the bush, hauling supplies and canoe over frequent portages, fighting flies and mosquitos, and taking chances on the treacherous northern lakes, when he might travel as the crow flies, directly to his objective—and all within the short space of a few hours at the most? Fully as safe as the older method of transportation, he finds air travel much pleasanter and more convenient. To this, "Jack" Hammell bears witness in the current issue of the *Canadian Mining and Metallurgical Bulletin*. "One hundred thousand miles of flying over the North country without a single air casualty; much of it over virgin territory probably never before visited by white men; some of it over regions that abound with possibilities for minerals; all of it effective for exploration and the establishment of bases and supply stations, and for the carrying of men and their tools and provisions"—this is his summary of nine months' progress of an aerial enterprise, which has been functioning, he says, "without interruption, during spring, summer, and now into winter."

Advantages of air travel are greatest where slow creeping over the surface of the earth is accompanied by the most discomfort. Its success in a primitive wilderness, as just described, together with its rapid growth in competition with rail transportation elsewhere, is indicative of an expansion in its use to come, the scope of which can scarcely be imagined.

Awaken a National Consciousness in Mining

. . . And Foster a Sane P

THIRTY-FIVE YEARS AGO, at the time of the World's Fair at Chicago, a German dignitary who was visiting our shores was asked what most impressed him in America. He replied, "You are a country of butchers, slaughtering and wasting the gifts of Nature." Had he phrased his thought in less harsh terms, his criticism might have passed unnoticed. We may well ponder these words, particularly in regard to those gifts of Nature which are offered us but once, and which if wasted can never be renewed. The mineral deposits constitute a resource differing in all respects from other forms of Nature's beneficent bounty; man's ingenuity can never duplicate nor replace them, an exhausted oil pool cannot be rejuvenated nor can an orebody be developed elsewhere than the place at which natural forces acting through geologic time have conditioned its habitat. Mining yields a permanent form of wealth from a transient source, whereas agriculture presents a perennial source of perishable wealth.

A paper presented before the San Francisco section of the A.I.M.E., Jan. 8, 1929.

Dr. Hubert Work, addressing the American Bar Association, said: "The demands on mineral resources are now so great that the nation needs to balance its accounts and see how long the Natural Reserve Bank can continue to honor its regular drafts. It is a wise nation that thinks of future needs and therefore lives within its means." Similarly, Dr. Fernow, of Toronto, counseled the American Association for the Advancement of Science in 1895 that "the problems of suffrage, taxes, and tariff are merely incidental . . . but the question of the economy of the resources which constitute and sustain the political, commercial, and social power of a nation will long claim attention. A nation may cease to exist as well by the decay of its resources as by the extinction of its patriotic spirit." How true it is, to use the language of our contemporary philosopher Dr. John Dewey, that with tremendous increase in our control of Nature, in our

THE WISEST *and most intelligent use of mineral resources seems to call for their consideration in terms of world requirements, rather than in the narrow interpretation of local requirements. An international understanding should be established in the use and exploitation of mineral resources, securing minimum hindrance to free flow along natural channels of trade. . . . No nation is sufficient unto itself, and an artificial barrier to distribution imposes a serious handicap to national growth. International co-operation may prevent duplication of effort and the accumulation of a surplus beyond the world's present needs. . . . The United States, conscious of its power, its immortality, provident of the mineral resources for today and that hypothetical beneficiary of the residual estate, posterity, should unite in the formulation and adoption of a conservation program, whereby the selfish tendencies of individuals will be curbed and the greatest good result to the greatest number.*

ability to utilize Nature for human use and satisfaction, we find the actual realization of ends, the enjoyment of values, growing unassured and precarious.

Water-power projects are wisely directed by commissions and bureaus, assuring to the people the utmost benefits from the harnessing of these renewable energy resources. The land returns its increase and the farmer looks to a benevolent government for relief "from the dilemma of his own fertility," nor is his voice raised in vain, for farm relief is a national political issue. The mining industry receives mostly kicks and few ha'pence from the representatives of the people, and yet it is of vital concern to the nation.

On April 1, 1868, Dr. Rossiter W. Raymond was appointed by the Secretary of the Treasury to succeed Mr. J. Ross Browne as commissioner for the collection of mining statistics of the United States. His report, now exactly sixty years old, exhibits such a comprehensive grasp of the importance of our mineral resource upon the future of the country, that, old as it is, it remains stimulating and helpful. He wrote in his letter of transmittal: "When the industry of mining is based upon a foundation of universal law, and shaped by the hand of educated skill, we may expect it to become a stately and enduring edifice. . . . Establishing everything else, it has not established itself."

Since that time the industry has grown to such proportions that the value of fabricated products to the consumer equals that of all the produce of farms and forests, but mere mass neither connotes dignity nor permanence. Now, as then, we may say that mining has not established itself on a sound foundation of economic law and order, even though the superstructure has assumed such colossal size. Under the urge to produce, wasteful practices have been followed; with unrestrained and unregulated competition immediate gain takes precedence over other considerations. Mining is the source of our present wealth, but we may pause to ask, are not our mineral resources also the basis of our future security? Some will urge that present-day interests should not be sacrificed for the uncertain needs of posterity. It is hard for a man to take a long view of factors that affect him personally, and in the maelstrom of daily circumstance we fail to get the value and perspective of passing things. Whether our motive be selfish or magnanimous, we are confronted with the necessity of rectifying, if possible, existing conditions and taking stock of the national assets. All will acknowledge the desirability of the elimination of waste, whether it be of time, money, human energy or mineral substance, and the co-ordination of production to essential demand, which is nothing more or less than a sound practical conservational policy, insuring the highest utilization of minerals mined and processed, and assuring permanence of the industry.

What is this conservation of which we so easily speak and by which it is expected to settle satisfactorily the problems of the mining industry? Many definitions are available, but no matter how we use the term the subject has to do with the relationship between natural resources and economic life. It is not restricted to the elimination of waste or miserly hoarding, but looks toward sound national development resulting from industrial expansion and the betterment of mankind. It is then a function of government, for individual impulse is inadequate for its accomplishment. Though it is a national problem it compels the attention of every citizen. We should begin a campaign of popular education as to the meaning of conservation and the necessity of the adoption of its principles, but, in doing this, extravagance of statement and emotionalism must be avoided.

"Conservation," an anomalous term, implies a broad policy of preservation consistent with a wise exploitation of natural resources, even though such uses tend eventually toward exhaustion. The natural resources of the earth are so varied in character and the requirements of our complex civilization so numerous that any attempt to analyze the subject, except in a very general way, leads to confusion of thought and distorted ideas as to its real purpose. The potential value of the natural resources lies in the possibility of their being convertible into some form that will minister to the wants of mankind, today and tomorrow.

When the effort, be it mental, physical, moral, or financial, to produce something is greater than the value of the product to mankind, then there is waste. Poor organization or misdirection of effort will inevitably result in waste. There is a vast difference between intensive production and extensive use of the product. The natural world was made for the human race, but as the human race is made up of many variables, differentiation be-

Program for Conserving Resources

Urges DEAN FRANK H. PROBERT
Of the College of Mining
University of California

THE RESULTS *of organized investigation should be presented to the mining world in useful form. Knowledge increases in proportion to its dissemination. Discussion of ideas and the interchange of thought should be encouraged. The ventilation of an idea often leads to fresh thought being brought to bear upon a subject. Spoken thought presents itself differently from the form it has while lying half dormant in the brain, and the presence of a listener will often crystallize the thought into something worth while. The failure to exchange experiences between men is a great engineering waste and an obvious cause of inefficiency. "No secrets—the secret of our success" would be a profitable slogan to adopt. Operations behind closed doors lock out infinitely more than they lock in.*

tween economic output and waste is dependent largely on local conditions.

The subject has a strong appeal, it has been much discussed, but as yet without tangible results except in restricted fields of endeavor. The larger aspects of the problem have been neglected as far as remedial measures go. This is in large part because of the ignorance or indifference of those not directly engaged in mining. Unwillingness to change from old-time practices, and the lure of quick returns, are contributory causes, but aside from these human factors political and economic influences are retarding conservational effort. The question of character of ownership of the mineral resources, whether public or private, is before us, as is the nature of the organization of existing industries, the powers, privileges, and prerogatives vested in corporate enterprise. Transportation, taxation, oppressive legislation—these are vexatious matters requiring public action to rectify. Workers in conservation are loosely knit together, with much energy dissipated, there being no unified purpose or direction. There is no central agency viewing our resources as a whole in their relationship to industrial, economic, and social stability. If the problem is to be solved, it demands leadership and organized effort.

Time will not permit of a discussion of the varied aspects of the conservational problem. I may but touch the outer edge of some of them. Waste is an ambiguous term; we sense its meaning but cannot satisfactorily define it. It may be absolute or relative; it may tend toward total loss or prodigality. It is necessary that we first realize the varied sources of waste before we can make plans for the conservation of materials. Under existing economic conditions and our limited knowledge of scientific possibilities, waste will continue, but the trend of thought should be toward the saving of valuable substances so that posterity can enjoy them. This subject offers one of the most enticing and remunerative fields of research for the experimentalist, not only in the prevention of further waste but in the beneficiation of the material that has already been discarded.

Possibly the usage of fuel is the most prolific source of waste known, and with all our modern improvements for the development of power, the industry is none the less one of the most inefficient. It is claimed that in the exploitation of our coal measures there is an annual wastage of 200 million tons, two-thirds of which is as pillars to support the roof. Should we regard this as waste when it is a means of conserving human life and existing wealth? To support the ground by other means than the coal itself would add greatly to the cost of winning the coal. It becomes a question of expediency, of cost. By far the larger part of the energy stored in coal is lost because of improper combustion through inefficiency of steam boilers and steam engines. It is estimated that boiler scale in locomotives used in this country by the railroads necessitates the burning of 15 million tons of coal annually. This is a waste which, in a large measure, can be prevented. In coke manufacture in beehive ovens the losses are unbelievable. If this coal should be coked in retorts, it is figured that, exclusive of the byproducts, approximately one million horsepower could be developed from the carbon which is now lost.

The exploitation of both the solid and liquid fuels is accompanied by great losses. In California alone, about 217 million cubic feet of natural gas is dissipated in the air daily. The U. S. Bureau of Mines estimates that in the petroleum industry there is an annual loss from one cause or another amounting to $50,000,000.

To what extent these losses might be avoided, it is hard to say. Academic discussion may be enlightening, but experience speaks louder than the philosophers. We must not be misled by the doctrines and theories of conservationists of the extreme type. If we are to realize the full benefits of conservation, it becomes necessary to distinguish clearly between the relative values of the assets sought to be conserved; otherwise waste of the more valuable may result from the efforts to conserve the less valuable. We cannot disregard the demand of invested capital for adequate interest and redemption.

True conservation means improvement of processes and avoidance of waste. The present generation is entitled to take from the earth that which it justly needs, provided it does not wreck and destroy and unduly waste a part of the earth's resources. As our knowledge advances, future generations can utilize material that today is uncommercial.

Organized investigation and study of mining and metallurgical processes play a tremendously important part in the real conservation of our resources, for if we can bring to the point of commercial use leaner and leaner material, so we can extend the life of our mineral industry.

Science is the road to Utopia. There must be organized investigation, the results of which should be presented to the mining world in useful form. Knowledge increases in proportion to its dissemination. The discussion of ideas and interchange of thought should be encouraged at all times. The ventilation of an idea often leads to fresh thought being brought to bear upon the subject. Spoken thought presents itself differently from the form it has while lying half dormant in the brain, and the presence of a listener will often crystallize the thought into something worth while. The failure to exchange experiences between men is a great engineering waste and an obvious cause of inefficiency. "No secrets—the secret of our success" would be a profitable slogan to adopt. Operations behind closed doors lock out infinitely more than they lock in. It is a great mistake to work with too intense concentration, with your vision too firmly focussed on your own enterprise, oblivious to all else that is being accomplished around you.

Co-operation is a useful tool to the conservationist. Knute Rockne, the famous football coach, writing in *The Nation's Business,* said, "Organization is a fusing of many individualisms into a dynamic, astute group mindedness, a co-ordinated initiative." Co-operation does not put a premium on mediocrity, but rather discovers and develops leadership. It is not a sentiment; it is an economic necessity. In this day of rapid, almost revolutionary changes in our economic and commercial processes, it seems almost axiomatic that business must have a broad vision of organization, the courage of group action, and also the close interplay of teamwork if it is to meet successfully the challenge of new conditions. Constructive co-operation will reduce competition.

Mr. Herbert Hoover, as Secretary of Commerce, initiated a program of simplification and standardization in industry which I venture to say has far exceeded even his conception of its possibilities. Although we will all agree that no two mineral deposits are alike in their physical character, and that mining practices are not reducible to standardized methods, nevertheless little warrant appears for the diversity of materials and machines

offered to the industry. The flotation process has simplified flow sheets: possibly a comprehensive study of the hardness and toughness of rock masses will lead to fewer and cheaper methods of breaking and handling ground. Nature is a willing servant when conscripted into the army of workers with understanding and appreciation of her worth. Why not put her on the pay roll? She demands neither wage nor recognition. Why not use part of the natural gas now going to waste to build up back pressure in the oil sands? Why not substitute induced stress for dynamite in the stopes, and natural comminution in caving masses for coarse-crushing devices? Why not prevision the metallurgical simplification by realizing that the conditioning of pulp starts in the stopes? Dreamy suggestions, perhaps, but within the range of possibilities.

Regulation, wisely conceived and properly administered, may not only bring about larger returns and greater opportunities but prolong the life of many mining projects. The goal may be approached by two avenues, enlightenment wherein the free will of operators will inevitably be exercised, or compulsion with perhaps restraint or inhibition, of which we already have too much. The education of the public in these highly important matters should not be left to the cloistered pedagogue, whose utterances may receive a respectful hearing, but whose preachments carry little weight in the world of affairs; it is your duty, as it is mine, to stimulate a public mineral-mindedness. If such eminent mining men as Mr. Hoover, Cornelius Kelley, George Otis Smith, Bain, Notman, Merrill, Leith, Ingalls, and others can ardently espouse this cause, surely we lesser lights can contribute, whenever occasion offers, to the dissemination of such knowledge as we have. Is it too much to hope that our Assemblymen and Congressmen at Sacramento or at Washington may change from "demagogues whose concept of public duty is to direct their efforts to catch the whimsical echo of a temporary popular approval" to representatives of the people, conscious of their desires and needs, who without swapping of votes will courageously advocate a righteous cause? Disraeli lamented long ago, as we may today, "the world is weary of statesmen whom democracy has degraded into politicians."

Education to be of value must be sound. There is much misinformation abroad concerning the mineral kingdom, misconceptions as to the profitableness of mining operations, with consequent miscarriages of justice in matters of taxation. The much discussed report of the Committee of Eleven of the American Petroleum Institute is, in my opinion, grossly misleading and gives to the layman a sense of false security. In wild optimism the report proclaims that the waste in industry is negligible; that there is a billion acre reserve, 57 per cent of the area of the country being underlaid by sedimentary rocks in which oil may be found, and as if this were not sufficient, it estimates that in areas susceptible to computation there are 735 billion barrels of petroliferous substance. Why worry about oil? Compare this bombast with the dignified findings of the Committee of Nine, appealing alike to personal intelligence and ethical ideals.

Direction and order may result from wise legislation. Statutory prohibitions have been formulated to correct abuses of production, but many of them are antiquated and should be repealed or modified to meet today's issues. Integration of industries, approved combinations, group policies, will lower costs, yield ultimately great quantities, and, more than anything else, stabilize conditions. Legislation should be aimed toward national welfare, and individuals must tolerate regulation. Self-regulation is more desirable than government dictation. Can the producers outline a plan of self-determination?

Dr. Le Neve Foster, from whom I received inspiration as a student at the Royal School of Mines, London, argued that mining was the most comprehensive of all fields of endeavor, involving scientific, technical, social, economic, and political problems. It is a basic industry, contributes to all industries, but calls for a knowledge of all human activity. It is neither local nor provincial. Its workshop may be delimited by the verse of Don Blanding, the Hawaiian poet:

> "West of the sunset stands my house
> There, and east of the dawn;
> North to the Arctic runs my yard;
> South to the pole my lawn."

Conservational measures must be looked at in the large. National programs must be co-ordinated. The wisest and most intelligent use of mineral resources seems to call unquestionably for their consideration in their world relations rather than in the narrow interpretation of local requirements. There should be an international understanding in the use and exploitation of mineral resources which will result in minimum hindrance to the free flow along natural channels of trade.

Minerals are locally segregated, regardless of geographic boundaries. No nation is sufficient unto itself, and any artificial barriers to distribution impose serious handicaps to national growth. Reasonable precautions, not prohibitive measures, should be taken to maintain, as between countries, differences in standards of living and permit the expansion of industry. International co-operation may prevent duplication of efforts and *the accumulation of surplus beyond the world's needs.* Unmined mineral costs us nothing. In Nature's storehouse it pays no rent; there the rust and moth doth not corrupt, nor do thieves break through and steal. It is available at our command, ready for any emergency, in peace as in war. The question of reciprocity in international commerce is, I know, a delicate one, yet none the less momentous and integral to any discussion of conservation.

I have not meant to add to the frigid theories of a generalizing age, and trust that some irritating thought I have expressed may goad you to action in support of an industry which concerns not this fraternity alone but is a matter of public welfare. This country, conscious of its power, its immortality, provident of the mineral resources for today and that hypothetical beneficiary of the residual estate, posterity, should unite in the formulation and adoption of a conservation program, whereby the selfish tendencies of individuals will be curbed and the greatest good for the greatest number result.

A Formula for Geologists

"A LEAD-SILVER OREBODY in its manto and precedent phases always follows the course of least resistance from its igneous source to the surface." This general formula, applicable, says A. R. Fletcher, to all limestone lead mantos, is enunciated and expounded by him in an article entitled "Mexico's Lead-Silver Manto Deposits and Their Origin," soon to appear. Readers who recall the article by Basil Prescott on limestone deposits of this type, which was published in the *Engineering and Mining Journal* of Aug. 14 and 21, 1926, will find this further discussion of interest.

Application of the *Petrographic Microscope* To Research in Ore-Finding Geology

PART II

By Norman Smith
Geologic Engineer, Waverly, Mass.

Part I of this paper, published in the issue of March 2, dealt with geologic research and the several factors involved in applied petrography. In Part II petrographic studies of orebodies are considered.

THE petrographic microscope has been used to describe in minute detail about 700 rock samples from mining areas at Hedley, B. C., Canada, and Tintic, Utah, in the United States. The object has been to discover to what distance from an orebody indications of its presence could be found. Results, as idealized in Fig. 2, show that the presence of an orebody can be safely inferred from microscopic changes in the wall rock at distances of 1,500 to 2,000 ft. from the orebody. The mining industry in general should be interested in the petrographic procedure used at Tintic and Hedley. Before outlining the results found at these camps, a brief description of their general geology will be given. A theory will be proposed for explaining the conditions found with the microscope. After these considerations, the reader's thoughts will no doubt turn to the general range for application of the principles, as well as the mode in which they can help specific and local problems. On both these questions all the conclusions that are possible from my investigations, as well as a description of the petrographic procedure, will be set forth.

Norman Smith

For a good start 100 properly located samples have proved sufficient for a district the size of Hedley or Tintic. From these, about 30 are chosen for their great variety of geologic occurrence. On each of these, at least 250 observations are made. Every observation that is worth a thought is noted, and in this way six 8½x11-in. sheets of notes have been made for each sample. Needless to say, the taking and keeping of notes must be as systematic as possible. Every square millimeter of the first 30 samples is covered in this manner under high magnification. It has been found better to apply systematically the higher magnifications (0.8 mm. field of view) at once, as critical data are too rarely seen with lower magnifications. In this work the compound mechanical stage made by E. Leitz, and shown in Fig. 3, has been a great help. The thin slice to be examined with the aid of the device is beneath the ¾-in. circular glass cover seen in the center. Both the cover and slice are mounted on the rectangular glass slide which is held by two clamps. A selected orientation in the clamps is maintained for each thin slice during all observations. Two screws on the stage allow moving the slice back, forward, and sideward, so that any point can be brought in the line of sight of the microscope. Thus, the 30-mm. scales with verniers to 0.1 mm. give every point on a slice a pair of fixed co-ordinates.

Use of the stage affords methodical examination of a sample. By affixing co-ordinates to notes taken, features of interest can be quickly relocated any time after the first observation. This has been found a great help when working with two minerals which greatly resemble each other—an experience that is frequent in examining altered rocks.

Only by such detailed work is it possible to avoid that common pitfall, the stereotyped, rubber-stamped interpretation. A more precise estimate as to the degree (quantity) of alteration is also thereby made possible. Such complete description of the sample affords a conclusive answer to the following question: Is a mineral to be classed as a constituent of the wall rock, as a gangue mineral, or as an alteration product (a wall rock mineral that has been changed by the action of ore-forming solutions)? To answer this, all the mutual rela-

tions of the minerals are noted. With the low-power magnification it will be found that several pairs of minerals occur, one member of a pair being, say, a primary mineral, and indistinguishable from its twin, a gangue

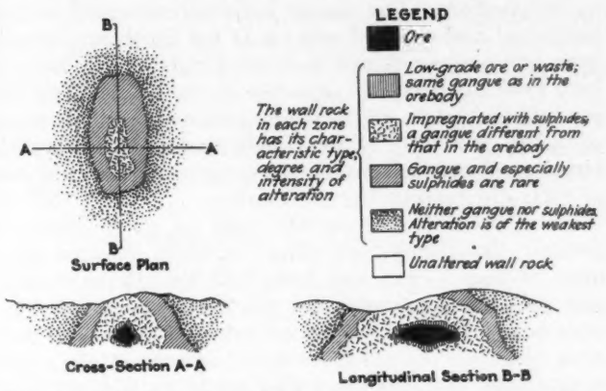

LEGEND
Ore
Low-grade ore or waste; same gangue as in the orebody
Impregnated with sulphides, a gangue different from that in the orebody
Gangue and especially sulphides are rare
Neither gangue nor sulphides. Alteration is of the weakest type
Unaltered wall rock
The wall rock in each zone has its characteristic type, degree and intensity of alteration
B
A
A
B
Surface Plan
Cross-Section A-A
Longitudinal Section B-B

Fig. 2—Schematic map of the petrography of an orebody

mineral. Under the higher powers the members of a pair will be found to differ as to luster, color, or cleavage. Usually, when enough observations have been made, it becomes possible to recognize one of these characters under the low power and to use it with confidence for distinguishing one member of a pair from its twin.

After the first 30 samples have been treated as described, the data obtained will be found to fall into a group after some general plan. For notes on the remaining 70 samples, a form such as shown in Fig. 4 can be drawn up. Use of such a form systematizes note taking, and makes the notes suitable for ready reference and helpful in comparative studies. About 100 observations on each of the 70 samples will be required in following the scheme established from study of the first 30. For a final report, the form shown in Fig. 5 is used; this has been slightly modified after that in use at Columbia University. Filling in the diagram presents a statistical summary of all notes taken on each sample. Under "Special Features" is given a summary in words of the material in the diagram; also the significance of textures, as well as a general interpretation of the individual sample. Sequences of samples are chosen which will bring out the relations of the petrography to known orebodies. A comparative study in each sequence is tabulated, discussed, and interpreted. From these comparative studies, a general discussion is worked up, giving the broader features of significance for the whole district. This last step might be termed the report proper, and should include conclusions as to where, and how much, further study will be of value. An experienced worker using such a system should be able to finish the 100 samples in from one to four months.

When the district has been studied from all angles, including this first petrographic report, attention will be found to narrow down to selected areas of limited extent. From them, more samples will be collected. Study of these may bring out the significance of uncorrelated data in the first 100 samples. To re-study the first 100, especially concentrating on the 70 that were not exhaustively treated in the beginning, may be of value. If the same man studies these additional samples, he should be able to dispose of them much quicker than was possible with the first 100.

At both the Tintic and Hedley camps, the ore is a massive bedded one replacing limestone. Other than this, the two are entirely different, except for features disclosed by the microscope. In East Tintic, where most of my work has been done, the ore is capped by acid flows from 700 to 1,000 ft. thick. Alteration of these flows, such as to indicate ore below, has been by barren siliceous veins which average 1 to 2 ft. in width. Alteration has been shown to have interpretive value where only three or four such veins occur in an area nearly a mile wide. The ore is a strongly oxidized silver-bearing galena, occurring in bodies several hundred feet wide and often 1,000 ft., or much more, in length. Lindgren[6] classifies Tintic as a mesothermal (moderate temperature) deposit. At Hedley the wall rock is an alternation of diorite sills, limestone, and volcanic breccias. Sills, which average about 100 ft. in thickness, are very abundant, and their alteration indicates the location of orebodies. The largest orebodies known are 400 ft. wide and 1,600 ft. long; the ore is a gold-bearing arsenopyrite type. Lindgren[6] classifies the deposit as pyrometasomatic (contact metamorphic).

Petrographic Features Common to the Two Camps

To Paul Billingsley, of Salt Lake City, Utah, I am indebted for the opportunity of carrying out the Hedley and Tintic work. I assume, however, full responsibility for all interpretations expressed in this paper.

Conditions at the Hedley and Tintic camps are so alike that a composite sketch will illustrate best what in general can be expected in a third camp. Such an idealization, as presented in Fig. 2, will make clearer the principles involved than would a more detailed description. At Tintic there are large areas uniformly of but one intense type of alteration, and so far it has been impossible to assign these areas a definite position in the halo. As no development within such areas has found ore, the alteration probably does not deserve any position in the ideal orebody halo. Microscopic quantities of gangue and sulphide have been found to occur in a

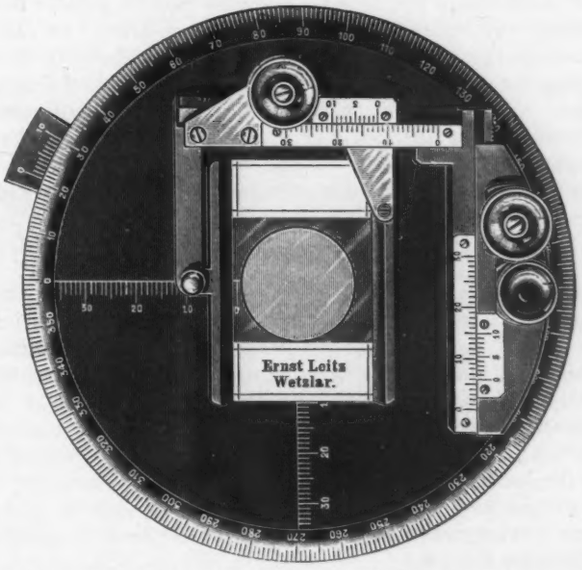


Fig. 3—Plan view of the compound mechanical stage used with petrographic microscopes

halo around orebodies—that is, a halo with a possible maximum radius of 1,000 to 2,000 ft. Width of zones in the halo will vary according to the size of orebodies, and their width relative to each other will, of course, be

[6] "Mineral Deposits"; 1928; pp. 663 and 816.

TINTIC PETROGRAPHIC NOTES

Date Field Number Description Number

GENERAL ALTERATION %

Dominant Alteration Products:

Textural Changes:

DETAILS OF PHENOCRYSTS

QUARTZ:

Number: "Cracking": Shattering:

Euhedral: Resorption: Granulation:

Subhedral: Size: Angularity:

Anhedral: Form of Extinction:

FELDSPAR:

Euhedral: Subhedral: Anhedral:

Alteration: %; Distribution:

Alteration Products:

Plagioclase: % (of Total Feldspar) Orthoclase: %

Other Feldspar: %

BIOTITE:

Euhedral: Subhedral Anhedral:

Alteration: %; Distribution:

Alteration Products:

Bleached: "Burnt": Loss of Pleochroism:

Leucoxene Coating: Loss of Birefringence:

GROUND-MASS INTRODUCED MINERALS

Of Rock % Altered %

Primary Minerals: Amount:

Secondary Minerals: Value of Criteria:

Fig. 4—Form for petrographic notes

different under the diversity of geologic settings found in different districts. Zones need not encircle orebodies even as regularly as shown, and the division into zones may sometimes have to be done somewhat arbitrarily. In some camps the number of zones may be greater than shown; in others, silicification, dolomitization,[7] or other processes may so strongly dominate quantitatively as to make the distinction of several zones in the halo a delicate task. So far the work shows that a sequence of zones found in any district will all be present in each halo regardless of the size of the orebody. The variation occurs in having narrower zones and less alteration within zones around the smaller orebodies.

Theory to Explain the Conditions Found

As explained in the foregoing, the petrography of orebodies has been discovered by a method purely empirical or inductive. Although the interpretations by the microscope are final, such a large number of properly located samples has been examined that the grand total of significance demand explanation, which if satisfactory should give those not using a microscope more confidence in the broader conclusions to which it has led me. With a satisfactory theory, it will also be possible to make sound inferences as to the range of application of the principles involved.

The theory need involve only two assumptions. Deposition of the ores must have been by rather dilute solutions circulating for an appreciable length of time. This is generally accepted for so many orebodies that it has become a local problem rather than a basic assumption inherent to geologic science. After depositing their load of sulphides, the solutions were dissipated by flow, diffusion, and vaporization into the surrounding barren walls. To form a massive orebody, they must have been constantly replenished from a reservoir, local and definite in its position. The second condition assumed is that brecciated and fissured ground is not in sharp contrast with non-brecciated, non-fissured ground, there being a very gradual transition from one to the other. The two conditions must be connected by assuming that the dilute solutions circulated in the fracture zone. Such a combination of assumptions is necessary to explain the sum of facts disclosed by the microscope.

Then, proceeding from the fault or other center of greatest disturbance, one passes through zones of fractures of microscopic, and, last of all, of sub-microscopic and sub-capillary size. On the larger openings solutions have circulated longer and more freely, so that near such openings the solutions have penetrated more into microscopic openings than they could on similar small openings farther from the center of disturbance. The amount of solutions circulating at any point is controlled by the resistance of openings to the circulation. This resistance is influenced considerably by the size of the openings, so that only minor amounts of solutions have penetrated out into the zone of microscopic fractures. Thus, for 1,000 ft. or more around orebodies, I find that solutions have circulated, the control every inch of the way

Fig. 5—Form for final petrographic report

PETROGRAPHIC DESCRIPTION

Date Collector

Field Number Description Number

I. FIELD NOTES

Locality:

Occurrence:

Question:

II. HAND SPECIMEN DESCRIPTION

General Appearance:

III. MICROSCOPIC STUDY FOR CLASSIFICATION

Original Texture: Size of Grain:

Original Structure:

Primary Process Represented:

Secondary Texture: Size of Grain:

Secondary Structure:

Secondary Processes Represented:

PRIMARY %	(Z) SECONDARY %
(X) Essential Minerals	Alteration Products (Especially Intermediate Products)
(Y) Accessory Minerals	
(T) TERTIARY Alteration Products (Especially End Products)	(O) INTRODUCED SUBSTANCES OR MINERALIZATION
(W) SUPERGENE Alteration Products Enrichment	(M) METAMORPHIC % Recrystallization Minelars

SPECIAL FEATURES:

ORIGIN OF THE ROCK:

CLASSIFICATION: PETROGRAPHER

[7] D. F. Hewett: "Dolomitization and Ore Deposition." *Economic Geology*, Vol. 23, pp. 821-64.

being by structure. At the farthest points reached by solutions, the control is by primary structures as much as by secondary fracturing. These primary features include all sub-microscopic openings of textures such as grain boundaries, twin planes, and cleavage planes of crystals. I intend to present at a later date a complete summary of all available data on factors influencing the migration of solutions. At Hedley and Tintic there are specific problems involving mineral sequence and periods of mineralization. These are proving worthy of more detailed study, and results of such studies will no doubt enter into any complete theory for explaining the zones shown in Fig. 2.

Limitations and Applications

As is usual with the great majority of ore deposits, those at Tintic and Hedley were formed in genetic connection with igneous rocks. Deposits at Tintic may well be in part epithermal (low temperature), and the deposit at Hedley is probably as high temperature as we can find, other than actual segregation deposits. I would expect for this reason that alteration of the wall rock and disseminated gangue will be found around all epigenetic deposits derived from igneous rocks. Variations in temperature, pressure, composition of solutions, and of wall rock may vary the results, but will never eliminate the results. From a consideration of Tintic and Hedley, no reason seems apparent for a deposit necessarily being in any particular form for the principles to apply. When previous development shows that bodies of commercial size can be expected, there should be no hesitation in studying veins (fissure, linked, and composite), sheeted zones, stockworks, and lodes. No doubt, application of these conclusions to disseminated copper ores, for which it is commonly assumed that primary deposition and secondary enrichment have been controlled by the same fracture systems, is also warrantable. In this case primary alteration of the wall rock should be a direct index of the grade of enriched ore below.

Secondary alterations, such as weathering, as well as primary alteration, are controlled, as to type and intensity, by the degree of primary mineralization. Such weathering could probably be shown to have a definite and direct relation to the gangue-sulphide environment which has been obscured by leaching.[8] Thus, for interpretative purposes, it would not be necessary for one to know whether an alteration product was produced by weathering or by hypogene solutions. The strong influence of gangue and sulphide on processes of weathering has been found to hold, in Tintic especially. The greatest value of the principles should be in suggesting new camps amenable to steam-shovel methods but not sufficiently developed to justify extensive drilling—particularly those camps containing disseminated lead-silver ore, gold ore, or copper ore, other than of the secondarily enriched type.

Deep Deposits Difficult to Identify

So far, no limitations to the application of the petrography have been met, though they certainly exist. If the orebody and the surface are separated by a post-ore blanket no trace of the petrography of the body will be found on the surface. The most common of such post-ore blankets are lakes, timber, underbrush, and glacial deposits. There may also be conditions where great thicknesses of sedimentary rocks or igneous flows are post-ore, and others where certain types and thicknesses of pre-ore shale could prevent the petrographic halo from reaching the surface. Orebodies existing at depths greater than 1,000 to 2,000 ft. would not be detected, and small bodies might go unsuspected at lesser depths. When a district is well dissected by underground development, all of the limitations mentioned in the foregoing can be avoided by taking samples from the workings. The surface may cut the halo along any horizontal plane. There is thus the chance that an orebody may be eroded away and only the footwall portion of the halo left. Such a difficulty, however, has not yet been encountered. Cases like this are probably rare and no doubt readily solved without confusion by reference to general field conditions. From work so far done, only a small amount of data are available on how completely a halo will encircle a body on its footwall. These meager data suggest that the halo will be continuous, especially at those points nearest the ultimate source of the ore. And, in the footwall portion of the halo, the inner zones of more intense action and the extreme outer zones of weakest action will dominate, the intermediate zones being narrower and less conspicuous than on the hanging-wall areas of the halo.

Factors Warranting Definite Conclusions

Within the possible limitations just enumerated the following inferences can be made about orebodies: After the outlines of a petrographic halo have been sketched in, it is known that an orebody exists and where. With great distances between orebodies, there is less chance of halos from two bodies overlapping each other. Thus, under such conditions the interpretation is simplified rather than made more difficult as when blind prospecting is done by any rule-of-thumb method. Comparison with known orebodies makes possible good estimates as to the size and depth of the body. The size of the halo and the degree (quantity) of alteration in the zones will reveal whether a large or small body is to be expected. Keeping in mind the relation of the size of the body to the size of the halo, the zones which are exposed at the surface will reveal the approximate depth of the body.

[8]Augustus Locke: "Leached Outcrops as Guides to Copper Ore"; 1926; p. 66.

Mining Engineering and Its Appeal to the Undergraduate

THAT a sufficient number of properly trained college graduates enter the mining industry each year is important if the industry is to progress as it should. In discussing this phase of the general subject of engineering education, numerous comments have been made by representatives of the industry that graduates with a sound understanding of fundamentals rather than a specialized technical education are desired. The course in mining engineering as offered at most institutions of learning would seem to meet this requirement. But is this course making the appeal to the prospective undergraduate that it should to provide an adequate supply of graduates? Information pertinent to this question was obtained recently in answer to a questionnaire sent to the mining schools of the United States by *Engineering and Mining Journal*. Conclusions drawn from this data will be presented in an article by H. D. Keiser that will appear in an early issue.

Crushing and Concentrating

MOLYBDENUM

IN THE FIRST PART of this article, published in the March 9 issue, the occurrence of the molybdenite at Climax, Colo., was described, and details of the method of mining were given. The crushing plant will now be taken up, the transportation of the ore to the mill by aerial tram, and its concentration to a high-grade product preparatory to shipment to the reduction plant in the East, or for export.

By WILLIAM J. COULTER
General Superintendent, Climax Molybdenum Company, Climax, Colo.

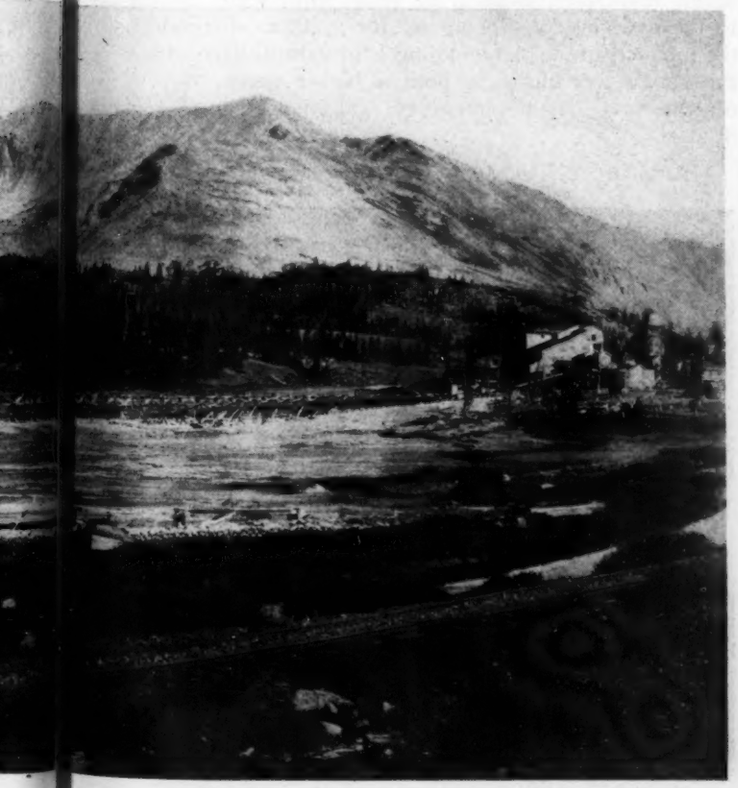
THE CRUSHING PLANT is situated at the mine below the mine ore bins. Here, approximately eighty tons per hour are crushed from 12 in. to ½ in. The mine bin has a capacity of 500 tons, from which three chutes feed to a 34-in. conveyor belt that carries the ore over a grizzly to a jaw crusher. The grizzly is a perforated chrome-molybdenum steel plate 2 in. thick with 2-in. holes spaced on 4-in. centers. Undersize drops on the conveyor belt going to the crushed-ore bin at the head of the tramway. Approximately 10 per cent of the tonnage going to the grizzly passes through as fines, and as the plate rests at an angle of 25 deg., practically all of the undersize is less than ½ in. Oversize from the grizzly goes to a 24x36-in. Allis-Chalmers "Superior" jaw crusher, making a reduction to 4½ in. This product is then conveyed over a Dings magnetic pulley to a conveyor feeding a Symons cone crusher. This is a 4-ft. machine, driven by a 100-hp. ventilated Allis-Chalmers motor using Texrope drives on 8½-ft. centers.

Surface plant at the mine

MORE *at Climax, Colorado*

Although the cone is occasionally used to make a reduction to ½ in., it is normally operated so as to give a product of 1¼ in. which is conveyed to a set of 20x54-in. Garfield rolls installed over a Cole screen set at ½ in. The rolls make a ½-in. finished product which is conveyed to the crushed-ore bin. The crushing plant is serviced by a 15-ton Armington crane.

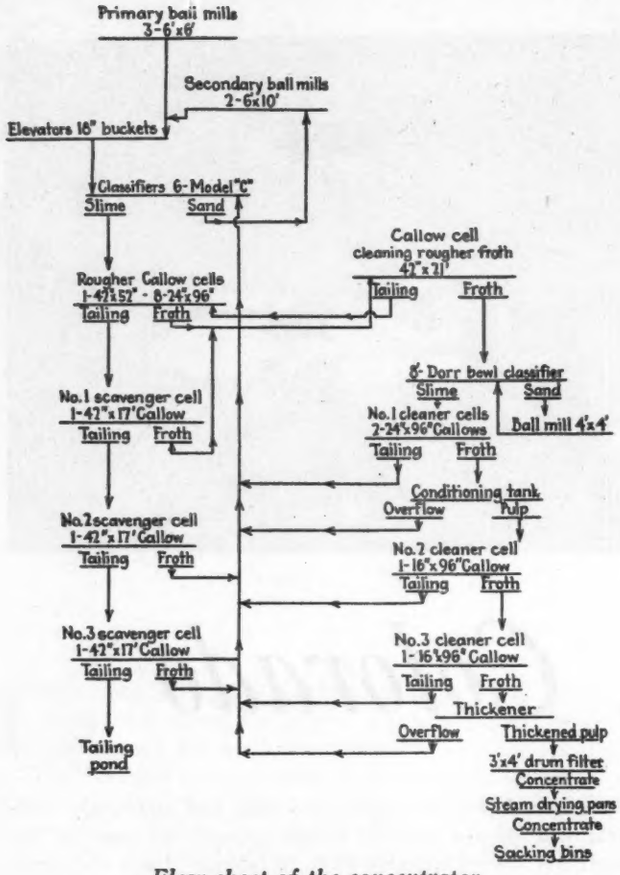
The crushed ore is delivered to the mill bins over a Leschen cable tram slightly less than one mile long. The tramway passes over no rough ground, so none of the eighteen towers exceeds 40 ft. in height. Lock coil track cable is used, 1¼ in. in diameter on the loaded side and 1 in. in diameter on the return side, the traction cable being ⅝ in. in diameter. The difference in elevation between the terminals is 486 ft., which is sufficient to make the tramway self-operating under fair conditions, but it is driven from the upper terminal by a 20-hp. motor, thus giving better control and steadier operation. Each of the 38 buckets used on the line holds an average of 940 lb. of ore. An average of 120 buckets per hour are delivered to the lower terminal, or between 55 and 60 tons, three eight-hour shifts supplying the mill with 1,000 tons daily. Three men on a shift operate the tramway, with two at the upper terminal and one man at the lower, with occasional trips of a fourth making inspection, oiling, and doing light repair work. The mill bin at both the upper and lower terminals is of 300 tons' capacity. No freight is handled on the tramway.



Tailing pond below the concentrating plant

The mill, as originally built ten years ago, was a 200-ton plant, but has been added to as demand for the product increased, until today it is treating over 1,000 tons. Although it cannot be called a modern mill in all respects, under normal performance a 90 per cent recovery and an 87 per cent concentrate is made, with an average ratio of concentration of 105 to 1, this work being done at an average cost of 70c. per ton, including royalties.

The ore from the bin is fed to three 6x6-ft. Allis-Chalmers primary ball mills by plunger feeders. These mills are equipped with standard type combination drum



Flow sheet of the concentrator

feeder scoops and $\frac{3}{8}$-in. grates, and are charged with 4-in. chrome-molybdenum steel balls. They are driven by 125-hp. slip-ring motors through a flexible coupling and herringbone gear. The discharge from these mills goes to a bucket elevator that delivers the product to six Model "C" duplex Dorr classifiers. Overflow from these classifiers goes to eight 24x96-in. Callow rougher flotation cells, and one 10-cell, 32 in. x 52 ft. rougher, and the classifier oversize to two 6x10-ft. Allis-Chalmers secondary ball mills. With the aid of another bucket elevator these mills are in closed circuit with the classifiers. The discharge ends of these mills have $\frac{3}{16}$-in. grates, and are driven in the same manner as the primary mills, with 150-hp. slip-ring motors. The secondary mills are charged with $2\frac{1}{2}$-in. grinding balls, the ball consumption per ton of ore being 2.6 lb. Classifier overflow goes to two 4-in. Wilfley pumps and from there to the roughers.

The froth from the roughers runs approximately 15 per cent MoS_2 and goes to a five-cell cleaner, 42 in. x 21 ft. The concentrates from the latter machine are delivered to an 8-ft. bowl classifier with the overflow set for 200 mesh; the oversize is in closed circuit with a 4-ft. Colorado Iron Works mill using $\frac{3}{4}$-in. balls. Bowl overflow goes to two first cleaner cells, 24 in. x 96 in., which raise the grade of the froth to 40 per cent, the concentrates next going to a 9x10-ft. wash tank, where more water is added, and from there to a third and fourth cleaner in series. From the fourth cleaner the concentrate is pumped to a 9x10-ft. Dorr thickener, where, at 50 per cent solids, it is drawn off by a No. 1 Dorr diaphragm pump to a 3-ft. Oliver filter, which reduces the moisture to 12 per cent. Afterward the moisture is further reduced to 4 per cent in steam-heated drying pans. The tailing from all the roughers goes to three 3-ft. 4-in. x 17 ft. scavengers in series, the tailing from the last machine going to the tailing pond. Froth from the first scavenger is returned to the five-cell cleaner, and the froth from the second and third scavengers to the classifiers. The tailing from the five-cell cleaner is returned to the roughers, and the tailings from all of the other cleaner machines are returned to the classifiers.

The flotation pulp averages 25 per cent on 100 mesh, though the concentrate is finer—between 5 and 7 per cent on 200 mesh. When operating on a 1,000-ton basis, a total of only 0.1296 lb. of reagents are used per ton, consisting of 0.0357 lb. of No. 100 Pensacola, and 0.0939 lb. of No. 5 General Naval Stores. Both the Pensacola and the No. 5 G. N. S. are added with Damon feeders just ahead of the roughers. In the past, xanthate was used as a collector and cyanide was used in turn, to depress the iron, but in present practice neither of these reagents is being used, and the metallurgical results are better now than formerly.

Bowl Classification Improves Grade of Concentrate

The grade and fineness of the concentrate have a direct relationship. By bowl classification prior to the flotation cleaner circuit, any desired size may be had by setting the overflow accordingly. This has been the means of materially improving the grade of the concentrate. In a large portion of the ore treated, the molybdenite occurs finely associated with the quartz; in fact, it is so intimately combined that 100-mesh grinding will not separate them, so that on a grind of 25 per cent on 100 mesh a serious middling problem is at hand. This is overcome by pulling the roughing circuit very hard, sending this froth to bowl classification, where the middling settles out and is reground in closed circuit with the bowl, thus taking it completely out of the main mill circuit. Owing to the bowl overflow being set for a 200-mesh product, the molybdenite in the middling is practically freed from the gangue, resulting in both a higher grade of concentrate and a higher recovery. The bowl classifier is

Some of the conveying and crushing equipment

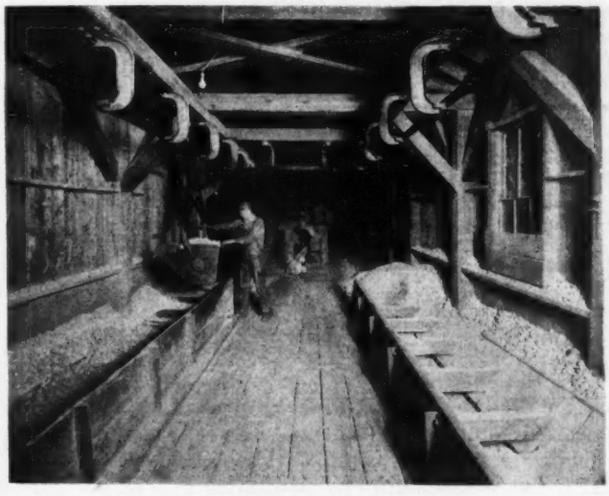
therefore one of the most important machines in the circuit.

The air pressure on the pneumatic machines is held at 4½ lb., the air being supplied by three blowers, two of which are used as spares. A No. 7 Sturtevant is driven by a silent chain drive; a No. 5 Roots is directly driven by a 75-hp. motor; and a No. 5½ Roots is driven with Texrope from a 100-hp. motor.

After being dried the concentrate is packed for shipment to domestic points in heavy jute sacks, not only very substantially made but also lined with a heavy paper which is cemented to the inside of the sack. Foreign shipments are packed in oak barrels holding 600 lb. From the mill warehouse the sacks or barrels are loaded directly into railroad cars.

Water Reclamation Necessary in Winter Time

Owing to a shortage of fresh water during the winter months it is necessary to reclaim water for mill use. The mill tailing, which is approximately 25 per cent solids, is treated in four Dorr thickeners, 18x40 ft., the pulp discharged from these tanks running over 50 per cent solids. The overflow, which is practically clear water, is returned to the mill by two 4-in. Wilfley pumps.

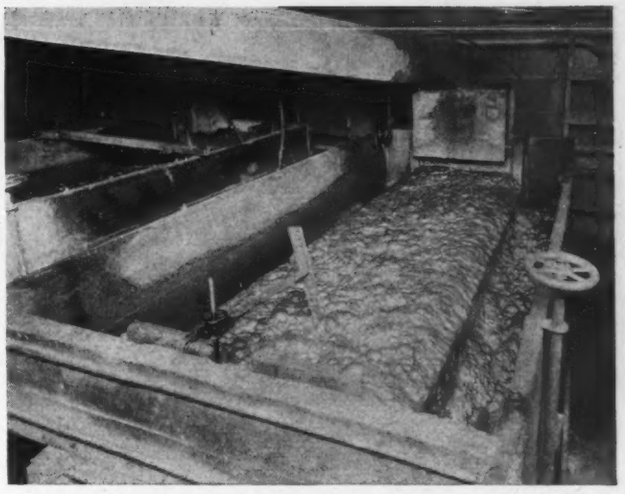


Terminal of the aerial tramway

The return water is practically free of colloids and oils, so has caused no trouble with either the grade or recovery. Further provisions have also been made for reclaiming water, even more effective and efficient than the thickener tanks. The discharge from the thickener tanks, containing 50 per cent solids, or the unthickened mill tailing containing 25 per cent solids, is caught in a large tailing pond with a capacity for approximately 2,000,000 tons of tailings, the overflow from which is clear water. It is returned to the mill through a 6-in. pipe line 3,000 ft. long. The pumping is done by an Allis-Chalmers Hydro-Cone pump of 300-gal. capacity, automatically equipped so that an attendant is not necessary. The latter installation will make the thickener tanks an auxiliary or stand-by unit.

Power Is Purchased

Electric power is delivered to the property by the Public Service Company of Colorado. It is delivered at 13,000 volts, and stepped down to meet the various requirements, most of which are at 440 volts. In general the power is dependable, but frequent interruptions occur during the late summer, when electrical storms are common. The power company is now installing a substation on the property that will derive its power from two plants instead of one plant, and thus insure better service.

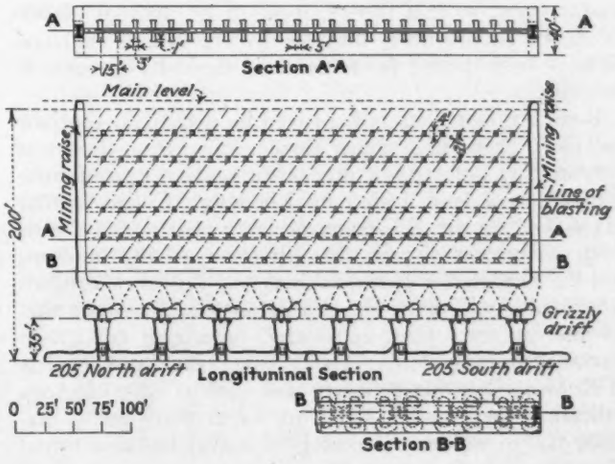


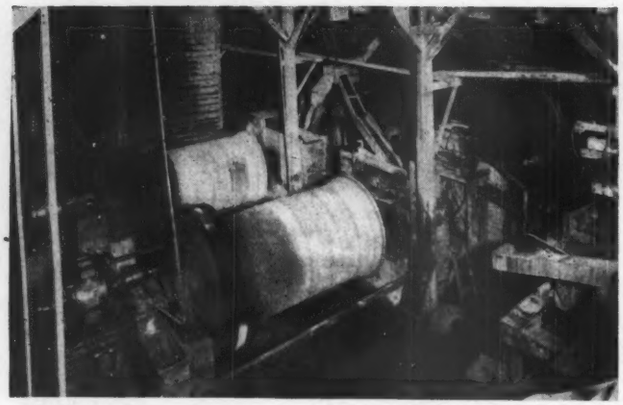
Froth overflowing the flotation cells

Molybdenum Steel Products Being Tried

As the use of molybdenum in steel is not fully developed, much remains to be learned as to the various fields of its usefulness, and naturally Climax is quite ready to investigate its merits for various purposes. The addition of a small amount of molybdenum greatly increases the toughness and hardness of steel. Such a product has many advantages around a mine and mill. At Climax, chrome-molybdenum grinding balls and ball-mill liners are being used, molybdenum roll shells have been used for some time, molybdenum jaw plates are in use on the crusher, and molybdenum mantles and bowl liners have been ordered for the Symons cone crusher, the main shaft of which is molybdenum steel as standard equipment. Molybdenum grizzly plates are used, all the mine drill steel has a molybdenum content, and the camp buildings are covered with "Toncan" corrugated roofing. As the normal life of practically all of the parts mentioned runs into months, patience is required to ascertain

Illustrated below is the method of removing pillars by using coyote hole system of blasting, as described on pages 397 and 398 of the March 9 issue





A part of the ball-mill installation

the comparative merits, especially as no out-and-out failures have occurred. The test on grinding balls, for example, is being conducted with 250,000 lb. of chrome-molybdenum steel balls; and the first set of molybdenum roll shells lasted nine months and accounted for 218,000 tons of ore, which is about 25 per cent better than shells previously used. Molybdenum drill steel, however, has been conclusively proved to be the best to overcome breakage, and so has been adopted as standard.

The total number of employees for the entire camp averages about 175. Four-room modern houses offer accommodations for twenty-five families. Central heating plants at both the mine and mill furnish heat to the bunk houses, mill, and boarding houses, and furnish hot water for the change rooms.

The Climax plant is now operating on a basis of over 30,000 tons of ore per month. The growing demand for molybdenum can best be shown by the increase in production at this property, as can be seen in the following tabulation:

MOLYBDENUM PRODUCTION AT CLIMAX

Year	Pounds of Molybdenum
1924 (5 months)	156,935
1925	821,757
1926	1,057,367
1927	1,858,228
1928	2,957,845

In the preparation of this article, the assistance of E. H. Roberts, mine superintendent, C. J. Abrams, mill superintendent, and Joseph Domenico, accountant, is gratefully acknowledged.

Rhodesian Drillers Seek Favorable Structure, Not Alone Outcrops

BY GEORGE L. WALKER

GEOLOGICAL investigation of the considerable area in Northern Rhodesia where highly important deposits of copper ore already have been found, supplemented by the disclosures of now quite extensive diamond, shot, and churn drilling at several widely separated points, has tended to show that wherever certain strata occur, copper is indicated. In consequence, it may come to be considered good business eventually to drill at almost any point where geological evidence proves those strata to exist, even though outcrops are deeply covered with soil. Should further exploration lend support to this theory, most of an area of 10,000 to 20,000 square miles may be drilled, just as coal and oil have been drilled for in some of the older districts in America.

Roan Antelope has now proved its deposit to continue for more than three miles farther northwest than was indicated by outcrops or any other surface sign of mineralization; a hole drilled by Rhodesian Congo Border has picked up the N'Changa orebody nearly half a mile west of the last sign in that direction of any outcrop; and the remarkably rich disclosures at Mufulira resulted from drilling to catch the dip of surface showings that no one, in years past, considered promising enough to warrant investigation. About two years ago Bwana M'Kubwa's N'Kana property was said to have outcrops indicating the possible strike of its orebody for a distance of 3 to 4 miles. A geological survey has now found that the ore-bearing sedimentaries there have a strike of at least 13 miles, and random holes are already being drilled to test them at depth. Although not yet officially stated, the sedimentaries at Mufulira, in which milling ore 58 ft. wide averaging between 5½ and 6 per cent copper has been disclosed by several drill holes, are understood to have a strike of 20 miles and quite possibly 30 or 40 miles. N'Changa has recently drilled a hole in an area where, a year or two ago, the hope was only remote that copper existed, and cut 110 ft. of ore averaging throughout 4.82 per cent copper. As the beds there have a dip of about 25 deg., the true width of the ore is approximately 100 ft. Though it is true that a relatively unimportant outcrop was found 2,000 ft. or so distant from the drill hole, this discovery is suggestive of the possibilities of drilling where there are geological indications only, and where no surface showing of copper exists.

Evidence is not lacking that the theory here outlined is subscribed to, in whole or in part, by many engineers and mining men. This is indicated by, for instance, recent heavy buying of the stocks of one or more Rhodesian prospecting concession companies by leading financial groups in London, which heretofore have not been identified with mining, not even with those mines whose shares are investments. It is further indicated by well-informed mining interests showing an eagerness to secure prospecting rights in the Northern Rhodesia copper region.

Is There Opportunity for an Extension of Old Age Pensions in the Mining Industry?

INDUSTRIAL PENSION SYSTEMS have had a threefold motivation—*relief, reward for service, and the desire for a stable and efficient work-force*—of which the first named has probably been the immediate consideration in most instances. Finding that the granting of assistance was to be a continual process, a number of industrial corporations have issued formal statements of policy concerning pensions. Under these plans, the relief aspects have been subordinated to general personnel policies and the pension has come to be looked on as a reward for service and an aid in stabilizing the personnel. Usually the pension applies to executives as well as to the rank and file. Only 128 of the 466 pension plans of industrial and business concerns and railroad companies that we have analyzed allow to the company entire discretion to fit the pension to the needs of the individual case. Plans classified as to the source of final pension payment fall into three groups: first, non-contributory, under which the company undertakes to bear the whole burden of the cost; contributory—under which the employer and employees jointly bear the cost; and contributory—under which employees' savings plus amounts granted from time to time by the company are paid to the employee at his request, either as a pension or lump sum. A few plans combine the first two methods. There are also 128 plans of the relief type to which we have already referred.

AT A JOINT MEETING in Chicago of the American Association for Labor Legislation and the American Statistical Association, Mr. Murray W. Latimer, of Industrial Relations Counselors, Inc., presented a paper on "Old Age Pensions in America." Four types of agencies are mentioned as having dealt with the problem: the state, as a social body; private charity; trade unions and fraternal organizations; and employers. The mining industry is principally interested in the last mentioned, and the abstracts here given from Mr. Latimer's address deal with the developments and opportunities for what are known as industrial-pension systems. The subject of human engineering is coming to the fore, as evidenced by a recent meeting of the Mining and Metallurgical Society of America, reported in the Jan. 26 issue of "Engineering and Mining Journal." Mr. Latimer's conclusions are based on the findings of a comprehensive survey. He sees little justification for expecting that industrial pensions will provide any large proportion of workers with protection against old-age dependency for some time to come, and believes that industrial pension systems of the future will partake more and more of the nature of compulsory savings

Typical provision of the non-contributory pension plans are:

1. For superannuation pensions, the employee must have served 20 to 25 years continuously with the company and be 65 years of age.

2. For a disability pension (72 per cent of the plans have this provision) 15 and 20 years of service, and no age requirement, are stipulated.

3. One, 1.5 or 2 per cent of the annual average salary for the last 10 years of service times the number of years of service is the amount of the pension.

4. Sixty-seven per cent of the plans have a maximum pension which ranges from $1,200 to 100 per cent of the average salary, used as the basis for the pension. Only 51 per cent set a minimum, and this runs as low as $10 per month.

5. With two or three exceptions, the employee acquires no right whatever to any pension or credit therefor until he fulfills all the requirements and is placed on the pension roll by the board of directors.

6. In about 40 per cent of the plans, the pension, once granted, is guaranteed for life, being subject to forfeit only in case of violation of some company rule or some criminal action on the part of the pensioner.

7. Very few of the plans hold pensioners subject to recall to active duty, except in case of complete recovery from disability.

8. Provision for dependents of pensioners is usually made by insurance and not through the pension plan, though in a few cases the pension (or half of it) may be continued to the widow until her remarriage or to the minor children up to their majority.

The contributory plans differ in only a few respects.

1. The employee is assessed from 25 to 75 per cent of the estimated value of the pension. Sometimes the company makes no promise as to what its proportion shall be, merely specifying that it will contribute such sums from time to time as it sees fit.

2. In case of death or withdrawal, the employee's contribution is generally returned with interest.

3. In a larger proportion of the contributory plans than of the non-contributory plans the pension is based on the whole salary rather than on the final or last few years of service.

In the last year or two, several companies have initiated benefit schemes on a contributory basis, which cover health and life insurance as well as pensions. The contribution usually is the same for all those receiving a certain wage, regardless of age. Consequently, if an employee withdraws before an equalizing reserve is built up, he forfeits all he has put in. Customarily, a part of the contribution will be returned after making five years' payments and the entire amount after twenty years.

The savings and composite plans are relatively unimportant and will not be considered.

The 466 plans which we have examined covered

4,000,000 employees at the end of 1927. Some three years before, the Pennsylvania Old Age Commission reported 370 plans applying to 3,300,000 employees. The difference in figures represents a different basis of inclusion, but also reflects a substantial growth in coverage. It is doubtful if a private survey can ever obtain complete information and the figure of 4,000,000 should consequently be taken as a minimum. For the 4,000,000 employees, the chief industrial classifications are:

	Per Cent		Per Cent
Railroads	42	Rubber products	2
Public utilities (other than railroads)	17	Agricultural implements	2
Metal products	17	Banking	1
Electrical apparatus	4	Mining	1
Food products	2	All other	10
Insurance	2		100

Detailed returns from 194 plans in firms with 2,500,000 employees show a total of 46,000 pensioners in 1927 and pension payments of $27,200,000. The average pension, therefore, is a little over $590. If this same ratio holds for all 4,000,000 employees, there were about 75,000 pensioners and about $43,000,000 being paid as pensions in that year. Remembering that the whole field has not been covered, we are probably safe in estimating that there are now probably 80,000 industrial and business pensioners in this country receiving approximately $50,000,000 annually in pensions.

Two years ago the Pennsylvania Old Age Commission estimated the number of pensioners as 90,000, with payments of about $50,000,000 and the average payment at $485. The estimate of the number of pensioners is probably a little optimistic, though, on the other hand, the pension payments seem too low. That the average pension has increased is probably due to the fact that recent pensioners have been granted higher sums than those of several years ago, and persons receiving the very low payments granted on the old wage level of ten and fifteen years ago have been dying out.

The tendency under nearly every industrial pension plan is for the number of pensioners to pyramid rapidly as time goes on. The average rate of increase of pensioners in the United States Steel Corporation has been 7.5 per cent during the past seventeen years, and in the Baltimore & Ohio 6.7 per cent over a period of 43 years.

Most corporations have charged to current income the payments for pensioners of the current year. It has become increasingly evident that such practice will ultimately result in a level of payments which no one organization can bear if it is competing with companies which do not have such charges. There is, too, a growing recognition of the principle that since the typical plan contemplates granting pensions related to the salary and service of the individual employee, the costs of future payments ought to be spread over the whole period of service, and that pension reserves should be accumulated during this period of active service. As yet, however, relatively few companies have accepted this principle to the extent of actually setting aside reserves from which future pensions could be paid. Probably the total amount of reserves accumulated at present will scarcely equal the sum needed for two years' pension payments. When we consider that at age 65 the typical pensioner has a life expectancy of twelve years, one can only conclude that adequate provisions for payments of pensions have not been made. If there is added the liability already accrued for persons who will receive pensions in the future, the unstable nature of industrial plans is emphasized.

It cannot be fairly stated, however, that there is any likelihood of a general withdrawal of industrial pensions in the near future. Despite the great growth of plans, the total pension payments, even in firms which have been established for a long period of years, are relatively small compared with total payrolls. Our investigation has revealed the greatest interest in the whole problem of pensions, and since a retirement scheme is by nature a long-term project, thus permitting amortization of accrued liabilities over a period of years, it seems safe to say that the majority of industrial pension systems will gradually work out of their present difficulties with no drastic modifications so far as the pension is concerned.

The weight of pension costs has been lightened by some firms through the adoption of the contributory principle. Prior to 1911, 10 out of the 57 industrial plans of which we have record, or 17½ per cent, were on a contributory basis. The proportion of contributory schemes to the total number established, by five-year periods, is:

	Per Cent		Per Cent
1911-1915	10.4	1921-1925	23.6
1916-1920	9.7	1926-1928	62.5

Several companies are also considering the reformulation of their plans along contributory lines. The forces which have led to the growth of this tendency will continue to operate during the next few decades, and the number of such schemes will probably increase. Industrial pension systems, therefore, will partake more and more of the nature of compulsory savings.

One other fundamental modification can probably be expected. Most of the plans at present base the pension on the salary during the last few years of service. If the company wishes to set aside amounts currently for future payments and, in addition, to require employees to pay part of the cost, some forecast of the salary in the years just prior to retirement must be made. Obviously, where there are extensive changes in the price level, such prophecy is extremely difficult. Moreover, even if the average amount is predicted accurately, discrimination remains between low- and high-salaried employees if the employees contribute and the pension bears a definite ratio to the individual salary. Finally, most of the insurance companies will not reinsure a plan on which the pension is related to the final years of salary. Because of these considerations, there is an inclination to make the salary during the whole period of service the basis of payment. Especially with executives, this change may mean that the ultimate pension will be lower than it would be if computed on the final years' compensation. For the rank and file of employees, however, in the absence of any severe fluctuations in the general price level, the change in pension will not be large.

From the point of view of employees, the chief disadvantage of the industrial plans is that they require a very long period of service to qualify for the pension roll. This fact, coupled with the lowering of the maximum hiring age, makes it impossible for many workers to receive an industrial pension. Thus far, there is no evidence to indicate a tendency on the part of industrial corporations to lower service requirements or to arrange for interchange of pension credits. Although the stability of employment has undoubtedly increased in the last few years, and although this condition may be permanent, one would hardly be justified in saying that there is much chance for industrial pension plans to provide any large proportion of industrial workers with protection against old-age dependency for some time to come.

INDUSTRIAL PROGRESS

Lubricating Oil Successfully Reclaimed by Automatic Machine

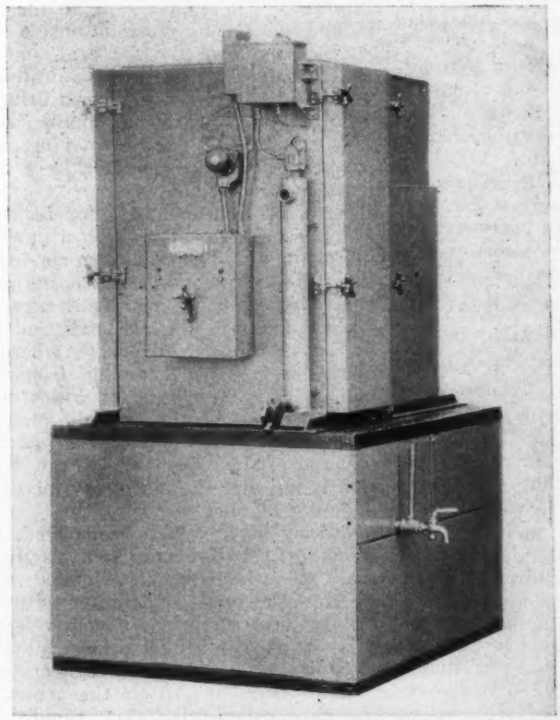
Process and Apparatus Developed in G. E. Research Laboratories — Little Labor Required and Product Is as Usable as New Lubricant

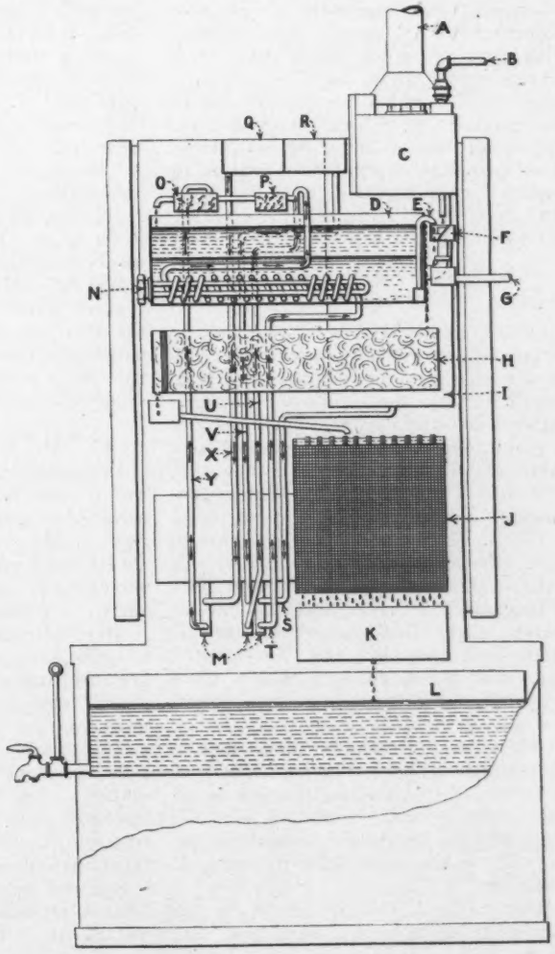
CONSIDERABLE money is wasted annually through careless and improper application of lubricants, whereby much of the oil and grease used has no chance to perform its function. This loss is paralleled by another, also great, caused by throwing lubricating oil away after it has been in use for a limited period and has become dirty, contaminated, or otherwise changed. The first of these losses is due in large part to the practice of hand oiling, involving perhaps the use of open oil holes, and the lack of up-to-date lubricating equipment and methods. Its remedy is obvious and was pointed out in the article by J. A. Martz in the *Engineering and Mining Journal* of March 16. The only remedy, however, for loss caused by throwing oil away while it still has possibilities as lubricant, is reclamation.

The feasibility of reclaiming lubricants hinges on whether or no oil "wears out" in service. Investigation as to what happens to an oil—say a motor crankcase oil—in service is therefore necessary. According to Dr. Charles Van Brunt, of the General Electric Research Laboratories, in a paper entitled "Crank Case Chemistry," the oil becomes opaque, black, odorous, and thin, its thinness being due to dilution by gasoline or the less volatile components of gasoline. Its outstanding characteristic is its lack of body or low viscosity, which means that it will form a thinner and weaker film between moving parts, permitting the minute abrasive particles to cut and scour and affording lessened protection under high load pressures, when the film may entirely disappear. In addition, sludge is formed containing water, dirt, and soot in what approaches a colloidal condition, the three components being inseparable by any mechanical means that can be devised.

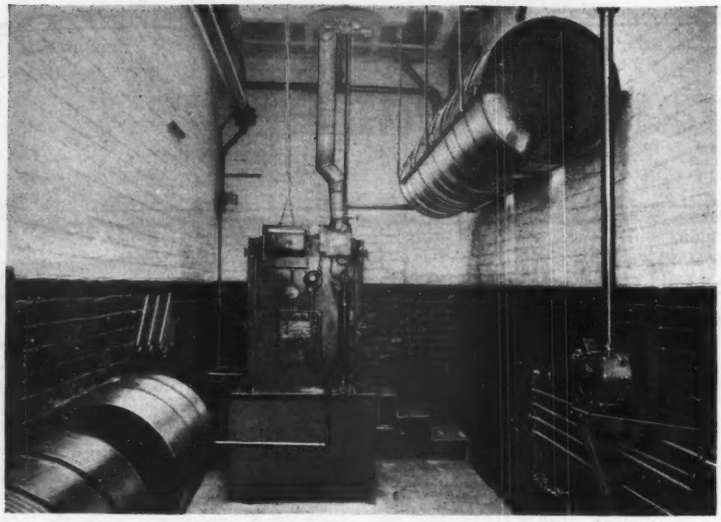
Oxidation, moreover, results in chemical changes in the oil which may be harmless or otherwise, those of the latter sort including the formation of organic acids, also of a sludge resembling tar or resin, and other substances which, added to the sludge and increasing its volume, tend to gum up

Below, an exterior view of the machine for reclaiming used lubricating oil. The sketch at the right shows the various parts and their relation to each other.





A—Vent pipe
B—Water inlet
C—Safety device
D—Clarifying tank
E—Sludge evacuator
F—Cup
G—Drain connection
H—Soap catcher
I—Supply tank
J—Rectifying plate
K—Heat interchanger
L—Clean oil tank
M—Pump
N—Immersion heater
O—Silicate mixer
P—Gelco mixer
Q—Silicate container
R—Gelco container



An oil reclaiming machine installed at the terminal of the Middlesex & Boston Street Railway Company, Waltham, Mass.

bearings and attack the metal surfaces. The sludge thus formed makes trouble in turbines and transformers and undoubtedly in automobile crankcases, where it is masked, however, by the black sludge formed in the combustion chamber.

The two classes of oxidation products, harmful and harmless or even beneficial, have one characteristic in common—an intense dark red or brown color, which all engine oils in use soon acquire (apart from the black sludge). This clear red color which develops in service is not to be taken as a sign of inferiority provided the harmful oxidation products have been removed. The history of the oil must be considered. Good products of oxidation accumulate together with the bad, and the latter must be removed if the oil is to continue at its best.

Lubricating Oil Does Not Wear Out

Oil apparently does not "wear out" in service, therefore, but simply undergoes certain changes, rectification of which, together with the removal of accumulated dirt and carbon, should leave it as good as new. As to the comparative value of reclaimed oil and new oil, Professor Peebles, of the Armour Institute of Technology, says:

"We have frequently had occasion to make laboratory tests of reclaimed oils and to compare the results with the tests of new oils. A great deal depends, of course, upon the reclaiming method which is used, but we have often examined reclaimed oils which gave practically the same tests as the original new oils.

"These tests tend to show that a lubricating oil does not wear out. If fuel ends, dirt, carbon, and other materials with which motor oil is contaminated are thoroughly removed, the oil will regain practically its original condition."

With respect to the statement "a lubricating oil does not wear out," the Director of the Bureau of Standards states:

"In service a motor lubricating oil does, of course, become changed even if contamination is prevented, for it is common knowledge that under conditions existing in automotive engines, oxidation and polymerization of the oil occur. However, if the oil be processed in such manner as to remove the oxidation and similar products, which are, generally speaking, a comparatively small percentage of the total oil, the resulting product will be, as far as can be told, equally as good a motor lubricating oil as was had initially. In this sense a lubricating oil does not wear out.

"The Bureau has analyzed a considerable number of samples of reclaimed crankcase oil and found many of them to show as great excellence in the commonly measured properties as do the so-called new oils. It is believed possible that such oils may be more stable than the new oil, because the more readily oxidizable constituents presumably will have been removed by the use and subsequent reclaiming."

What Reclamation Requires

Reclamation of crankcase oils, according to Mr. Van Brunt, in the paper referred to previously, involves: restoration of the viscosity, removal of the sludge, and removal of the deleterious products of oxidation, but not necessarily, or even advisedly, bleaching.

Mere filtration is not sufficient. Inasmuch as the components of the sludge are inseparable mechanically, the whole of the suspended matter must be removed to get rid of the abrasive material it contains. This could be done by filtering were it not that the sludge quickly clogs the filter. Moreover, filtration fails to correct dilution or to remove organic acids and deleterious substances dissolved in the oil.

Spurred on by the importance of lubricant reclamation, the General Electric Research Laboratories attacked the problem in 1920. By applying some old principles and discovering certain new ones, the research engineers succeeded by 1925 in developing a reclamation system and apparatus, which can be used successfully by anybody, Dr. Van Brunt asserts, wherever electric current is available, and which is automatic and continuous if desired.

Reclamation by this system and apparatus is effected in two steps, clarification and rectification. The oil is first treated hot with a small quantity of an inexpensive chemical called "Gelco," followed by the addition of an equally small amount of concentrated silicate-of-soda solution. In this way a sludge is formed which carries all solid and other impurities, even when present in microscopic or colloidal form. This sludge settles quickly, sinking into an underlying body of water which is constantly being pumped out and replaced by fresh water.

The diluents are next removed by passing the clarified oil in a thin film over electrically heated plates in a lively current of air. This method was adopted, inasmuch as rectification of diluted oil by heating in bulk requires temperatures well in excess of the figure at which rapid oxidation of the oil begins.

How the Machine Works

The machine, which is shown in the accompanying illustrations, is designed for 24-hour operation without attention, and all containers are built large enough to accommodate the various liquids for even longer. The apparatus is self-contained, so that no separate tanks are required. The supply tank in the machine is filled with dirty oil once a day. At the same time the chemical containers, *Q* and *R*, are filled with silicate and "Gelco" respectively. No measuring is required, the containers simply being filled to the top. The few moving parts in the machine are operated by a one-tenth horsepower motor.

Dirty oil and chemicals for reclamation are first passed through a measuring pump, *M*. The oil is then conducted through a coil around a thermostatically controlled electric immersion heater, *N*. The viscosity is thus reduced and the oil passes into a mixer, *P*, where it meets the "Gelco" coming from the pumps and is thereby mixed with it by a small paddle wheel. Then the mixture of dirty oil and "Gelco" goes into another mixer, *O*, where the silicate solution is introduced and thereby mixed in a similar manner.

Mixing having been completed, the treated oil flows over into a clarifying tank, *D*, which is partly filled with water. The immersion heater with the coil for incoming oil, previously referred to, is situated in the tank and maintains the contents at the desired temperature.

The sludge formed by the action of the chemicals settles very rapidly on being liberated in the tank and passes into the underlying water, bearing the impurities from the oil. This dirty water is constantly being evacuated from the tank through pipe *E*, and after

depositing the heavy sludge in a trap goes to waste through a drain *G*.

The oil moves slowly from the left to the right end of the tank. Clarified oil flows in a stream over a weir at the right and drops into the container, *H*.

Fresh water for the process enters the machine at *B* through a ¼-in. pipe, flowing into a box *C*. This is a safety device which automatically stops the machine if the supply of water is cut off. From the safety device the water drops into the cup *F*, and the proper amount to maintain the level within the tank passes in through the pipe below. Any surplus water runs over into the drain, *G*.

All acids in the dirty oil are removed. A small percentage of soaps remain in it when leaving the clarifying tank and are removed as the oil passes from right to left through the "soap catcher," *H*.

Freed from all acids, soaps, carbon, and abrasives, the clean oil still containing diluents drops from the left end of the soap catcher and, passing down through a tube, is distributed evenly in a thin film over electrically heated rectifying plates, *J*. A current of air induced by natural draft from below carries the gasoline vapors upward. They pass out of the machine through a sheet iron pipe, *A*, to an outlet from the building.

The rectified oil drops from the plates through the heat interchanger, *K*, where its heat is transmitted to the upward current of incoming air. The oil then passes into the clean oil tank, *L*. This tank is of sufficient size to hold a day's run. Its level can be gaged, and from it the oil is drawn off through the cock shown into drums or other containers.

The casing of the machine, including the doors, is well insulated. Electrical energy required for the heating elements is thus reduced to a minimum.

Cost of chemicals used is low, so that the reclaimed oil is available for use at a fraction of the cost of new oil. The saving thus effected makes possible not only more frequent changes of oil, with resultant decrease in maintenance costs, but enables the user to purchase the highest grade oil at lower ultimate cost.

This oil reclaimer, which is known as the "Refinoroil," is built in several sizes, the manufacturer being the Hilliard Corporation, 102 West Fourth St., Elmira, N. Y., which makes the machine under license from the General Electric Company.

The most important underlying principle of the process is the remarkable effect which silicate of soda (water glass) has been found to have, says Dr. Van Brunt. Chemically, this substance functions as an alkali, and as such its action is probably not different from that of any other alkali. It is the physico-chemical character of the sludge produced in the oil by shaking with the concentrated solution of the silicate that sets it apart from any other material, and that alone has made practicable the development of an automatic, continuous machine. The effect referred to is due to the large proportion of loosely bound silica in the reagent, which acts, in a way not yet fully understood, to form a sludge having three remarkable characteristics: it carries, or occludes, all of the substances extracted from the oil by the chemical action of the alkali, all of the carbonaceous, or gritty matter, and the water; it is of such density that subsidence is extremely rapid—in hot oil—a matter of minutes only; and, most distinctive of all, the settled sludge does not simply form a stratum at the bottom of the body of oil, as does that produced by other alkalies and coagulants, but sinks entirely out of the oil and into a pool of water, upon which the oil is floated after mixing with the silicate. This results in a dirty, black, aqueous liquor, which carries all of the impurities, overlaid by a clear oil layer, without any intermediate zone.

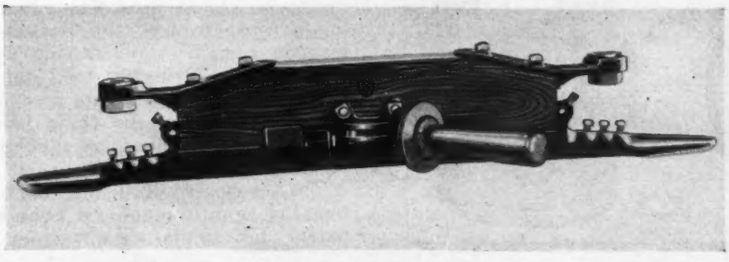
Only a small amount of labor is involved. It includes filling the "Gelco" and silicate containers and pouring in the dirty oil and removal of the clean, reclaimed oil.

At 3c. per kilowatt-hour current rate, the Hilliard company estimates the total operating cost, including power and chemicals, to be 10c. per gallon of reclaimed oil for either the 8-, 20-, or 50-gal. (per day) machine. The savings per year, at a cost of 50c. per gallon for new oil, are $1,022 for an 8-gal. reclaimer, $2,555 for a 20-gal. machine, and $6,387 for one of 50-gal. daily capacity.

Widen Application of Trolley Haulage Accessories

The pipe-suspension type of the Security mine feeder wire insulator used for supporting and insulating feeder wires is now being furnished for use with 1¼-in. pipe, according to the Ohio Brass Company, Mansfield, Ohio, manufacturers. Heretofore, this type of feeder wire insulator was made to take only a 1½-in. pipe. The insulator is shown in an accompanying cut. The same company also announces that its M-3 mine-section insulator switch used for sectionalizing the trolley circuit in mines is now being made to take 6-0 round or grooved wires. This switch is also illustrated.

A switch for sectionalizing trolley circuits in mines



Mine feeder wire insulator and supporter

High-pressure Lubrication of Mine Equipment —A Correction

In the article by J. A. Martz, entitled "High-pressure Lubrication of Mine Equipment Cuts Cost," which was published in the issue of March 16, 1929, the first sentence on p. 446 should read: "In addition, the saving in labor amounted to $3,662.40 per year." As erroneously printed in some of the copies mailed to subscribers, it reads: "In addition, the saving in lubricant amounted to $4,662.40 per year."

INDUSTRIAL NOTES

On March 23, the New York office of the Hardinge Company will move from 120 Broadway to the Chanin Building, 122 East 42nd St.

The business and good will of the Chrome Steel Works, manufacturers of Adamantine grinding balls, has been taken over by the Canda-Gayley Steel Corporation, organized by Messrs. Abeel Canda and H. Clifford Gayley, who have been the active managers of the Chrome Steel Works for several years. C. E. Meissner, who has been development engineer for the Chrome Steel Works for the last two and a half years, will be sales manager for the new company.

Interest in the application of internal-combustion engines in locomotive practice received a further stimulus in the announcement last month that the Baldwin Locomotive Works, of Philadelphia, had purchased a substantial interest in the business of the Geo. D. Whitcomb Company at Rochelle, Ill. The Locomotive Works has made an arrangement with the Whitcomb Company to sell the latter's locomotives and products in practically all foreign countries through its own representatives.

COST-CUTTING INNOVATIONS

Increasing the Footage Drilled per Bit by Use of Hard Facing Alloys

By A. E. Place
Mining Engineer, Los Angeles

THE remarkable drilling records now being made in Western oil fields with rotary drills, surfaced with cutting edges of hard metal alloys, promise to be of great interest to the mining industry. They point the way to a reduction of costs in exploring for mineral or breaking rock, in formations of moderate hardness.

Fig. 1—Six-way bit, faced with hard alloy, which dug 1,115 ft. of 15-in. hole

In Southern California, where indurated shales alternate with limestones of all degrees of hardness, and where everything new in oil tools usually gets its first try-out, the use of drill bits, core drills and reamers faced with abrasion-resisting alloys has become standard practice. It has given rise to a new and rapidly growing, special welding industry where the welder takes the place of the blacksmith or tool sharpener, and where drill sharpening means building up new cutting edges with special alloys on a worn-out drill. The ease with which such cutting edges can be replaced, or welded onto any kind of a steel or iron base, allows the driller to use the same bit over and over again without any loss of tool steel. It also makes it possible to do away with many of the special, high-priced steels heretofore used, and to substitute for them cheaper grades, or to utilize steels that have greater resistance to torsion or fracture, instead of trying to compromise such qualities in the same drill steel with resistance to abrasion or chipping, or with tempering qualities. Though new, and in many other fields as yet untried, the development of hard-surfacing materials and of the technique of their application are outstanding features of recent oil development and should be studied for applications in other lines of industry, particularly in mining and metallurgy.

Fig. 3—Application of granular hard-facing metal alloy with carbon electrode (seen at right)

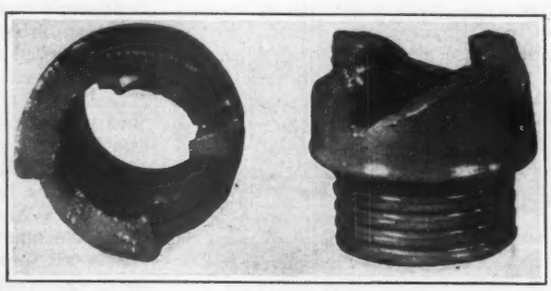


Fig. 2 — Diamond-drill bit notched and faced with hard-metal alloy

It is difficult to obtain accurate, comparative tests between faced and non-faced rotary bits, but the following quotation from a letter from the Smith Petroleum Company, with reference to two wells drilled side by side in Lawndale, Calif., with which I happen to be personally familiar, will give some measure of the great saving involved:

"On Sept. 6, 1928, at the Smith Petroleum Company well, Peck No. 2, Lawndale, Calif., I started drilling at a depth of 652 ft. with one of your six-way bits faced with Blackor. This bit drilled to a depth of 1,608 ft., making 956 ft. before coming out of the hole. I followed this with another six-way bit faced with Blackor and drilled to 2,723 ft., making 1,115 ft. of hole before coming out. The total time in the above two runs was nine hours and two round trips. On an offset well fifteen sets of disks were used in making the same amount of footage secured with the two Blackor-ed bits."

Fig. 1 shows the bit as it came out of the hole after doing 956 ft. of underground grinding. The two faced bits cost about $150, and the fifteen sets of new disks cost about $1,350, a money saving of $1,200, apart from the great loss of time involved and the wear and tear on equipment in hoisting up and down a long string of tools for each change of the fifteen sets of special steel disks. Blackor is the trade name of the tungsten carbide alloy used in this drilling.

The economy of using hard-faced tools as against non-faced ones is apparent, but similar results from other

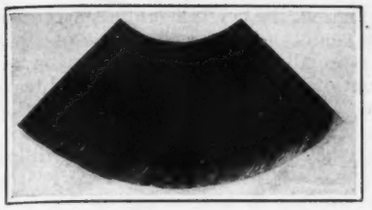


Fig. 4—A quadrant of a disk bit, hard-faced around the edge

users of hard-faced drilling tools are reported from many operators and different oil fields, as well as from churn-drilling operations, and with bits of all kinds of shapes or types. The hard-faced bit has come to stay in the oil fields and is rapidly crowding out the less resistant, non-faced special steel bits.

The success obtained in oil drilling by hard-facing rotary bits naturally suggested trials with hard-faced diamond-drill core bits for exploration. To get the necessary cutting edges for facing, and after conferring with J. B. Wilson, of the Continental Diamond Drilling Company, I had a number of bits notched as shown in Fig. 2 and had these also faced with Blackor about ¼ in. thick. They were then given to Granville Moore, a Los Angeles mining engineer who was drilling for limestone near Torrance, and to one of Mr. Wilson's field crews who were drilling in granitic schist near Glendale, Calif. Both engineers reported satisfactory footages and both jobs were finished promptly and satisfactorily.

According to their experience, from 20 to 100 ft. of hole per hard-faced bit can be expected in suitable rock formation with standard diamond-drill equipment. As these bits did not cost over $2 each (actual cost without profit to welder) including the bit head or blank (2½-in. outside diameter and 1⅞-in. inside diameter), the hard-facing material, and the labor of notching and facing them, the cost per hole of materials ranged from 10c. down to 2c. a foot. This more than offsets diamond loss, interest on diamond investment, diamond insurance, and the maintenance of an expert diamond setter. With drill blanks suitably hard-faced in a factory, and purchased ready-made by the gross, the costs per bit, the footage obtained, as well as the equipment investment per job, would be much improved. Also, the work could be entrusted to less skillful labor, or be done by the small operator himself.

In drilling through formations of varying degrees of hardness, where the hard-faced bits might not take good hold, diamond bits could readily be alternated with them, as the same standard diamond or shot-drilling equipment does for both. Hard-faced diamond drill heads or shoes have the advantage over shot drills, because they can be used at any angle, up, down or horizontally, and do not have to confine themselves to formations that have no crevices, or soft layers in which the shot is lost or becomes buried.

Further uses for hard-facing metals in the mining industry suggest themselves in churn drills, in the lining of tube-mill rings, of the edges of scoops, scrapers and dredge buckets, of teeth for steam shovels, of baffles for ore falls and mixers, for crossings, switches and frogs in rail work, repairs to stairways, ore ways or grizzlys, edgings for dams, impact mill liners, the edging of fans and vanes where there is cutting or scouring action, heavy cutting tools for lathes and planers, millers, saw blades for cutting rock and concrete and similar applications.

Not all hard-facing metals have the same resistance to abrasion, nor do all of them stand up equally well under different conditions of heat, of impact, or of acids and gases. To go into the merits in each case would require the writing of a whole treatise. However, the cost of trying out hard-facing metals for different purposes is not great. Scratch hardness and resistance to abrasion are not always related, and one offers no criterion for the other. The softer metal may resist abrasion better than the harder one, especially if the latter is brittle. Some of the alloys are harder after melting them onto a steel base than in the original form.

Fig. 5—Half of a detachable drill bit faced with hard alloy

Two principal types of hard-facing metals are in use—the inserts and the alloys. Inserts are loose grains of hard metal alloy, ranging from hardness 9 to 9.5 of Moh's scale (where talc is 1, corundum 9 and diamond 10). They are bonded onto a cutting blade by melting around them a softer metal. The inserts are held in place by a slight cementing effect or by overlap and shrinkage. Unless great care is taken in the welding operation, cracking of the bonding material may occur and give rise to loss of insert grains during drilling, with consequent wearing down of the drill tool. Tools faced with inserts rapidly wear to a ragged, irregular surface, and their use appears to be giving way to the harder metal alloys. The best known of the inserts are Thoran, Borium, Titan, Sulamite, Diamonet, Duridium, Tungsite, Vulcanite, and Redor.

Of hard-facing alloys in use here there may be mentioned Stellite, a mixture of chromium, cobalt and tungsten or molybdenum, with a hardness of approximately 8 when properly applied; Stoodite, iron chrome and manganese, with a hardness of between 7 and 8; Spartanrod, Diamondface (mainly iron and tungsten) and Plmite (iron, chromium, and tungsten). All of these metals are marketed in the form of little rods or sticks, about ¼ of an inch thick. They are applied with the acetylene torch. Blackor is marketed as black granules, of about the size and appearance of very coarse black powder, which crumbles between the fingers, and breaks down in water to a black fine powder. Blackor does not melt in the acetylene torch and has to be applied with the carbon electric arc. It has a hardness ranging from 8.6 to 9.2, according to the amount of intermelt allowed by the welder between the base and the hard-facing metal, and the number of coats applied. (See the illustration in Fig. 3.)

It is a matter of trial to find out which of the different hard-facing materials will best serve any particular purpose. For the foregoing drilling jobs various metals were tried out with widely differing results and greatly differing resistance to abrasion. In all tests due allowance must be made for the skill of the welder, who can modulate the degree of hardness of the facing metals by allowing too much melting and mixing, or by adding several coats. Too much facing metal makes for brittleness. A perfect bond similar to that shown in Fig. 4 is obtainable only after the welder has developed considerable skill. Fig. 4 shows a disk bit plate faced with Stoodite, and Fig. 5 a bit faced with Blackor, showing difference in flow line in each case.

Though a hard facing cannot well be removed from a surface to which it has been once applied, without cutting out the base metal, the facings can be trimmed or ground to a small extent with aloxite or special carborundum wheels. In practice, a sufficiently smooth edge can generally be obtained by laying the tool to be faced flat, and banking it around the edge with thick plates of copper to prevent overflow.

The use of hard-facing metals in the mining industry opens new possibilities in a number of fields. It tends to reduce costs and gives greater endurance to tools and equipment. Detachable drill heads for electrically driven rotaries faced with hard alloys can be used to advantage in many of the softer formations. They may eliminate the drill-sharpening equipment, the blacksmiths, and the large assortment of various lengths of consumable drill steels, and they may make it possible in some operations to dispense with compressed-air equipment and cheapen operations by making practicable the use of electricity for breaking ore. There is a great future for hard-facing alloys in mining.

BY THE WAY

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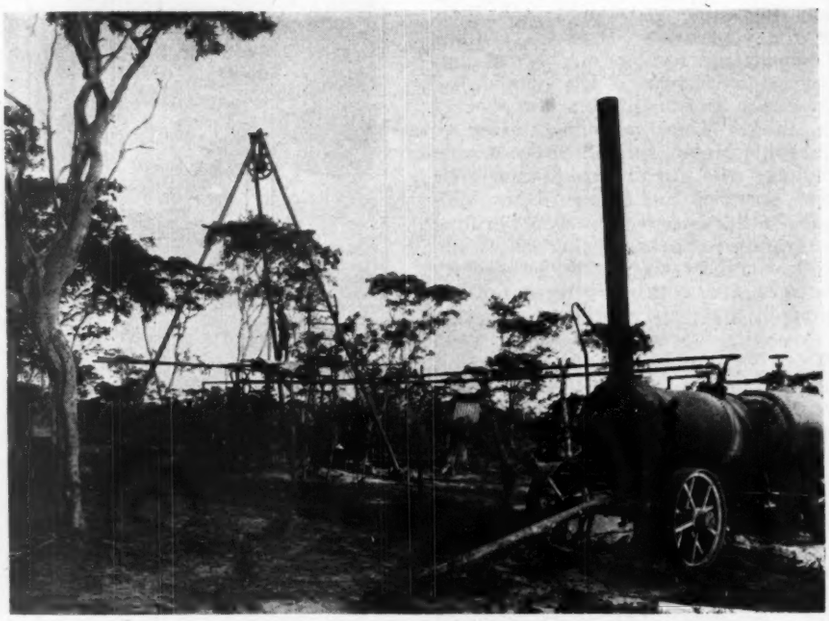
Main headgear of the Wesselton diamond mine at Kimberley

The Pictorial Story of Industrial Diamonds

ONE does not need to be particularly interested in diamonds for industrial purposes to give willingly a few moments to a most artistic photographic brochure on this subject just issued by J. K. Smit & Zonen, of Amsterdam, Holland, commemorating forty years' service. A copy of this publication has reached the editorial desk through the firm's American agents, The Van Itallie Company, 90 West Broadway, New York. In addition to the beautiful photographs of diamond mining and cutting operations, the introductory remarks are enlightening.

The importance of the use of diamonds in boring operations was suggested to Mr. J. K. Smit, of Amsterdam, in 1888. Amsterdam manufacturers of cut diamonds were only too anxious to sell stones that were too hard or cross-grained to cut for gem purposes, but these were just the stones that gave the best results for industrial usés. When the formation of diamonds is in regular layers, they are easy to cut, but if they are all grown together (technically called "feinig" or "naetig") it is impossible to cut them. In the Ballas formation, the crystallization starts from one central point, so this class of stone is especially fit for drilling uses on account of its greater freedom from breakage. Stones of the Ballas formation are, however, very scarce.

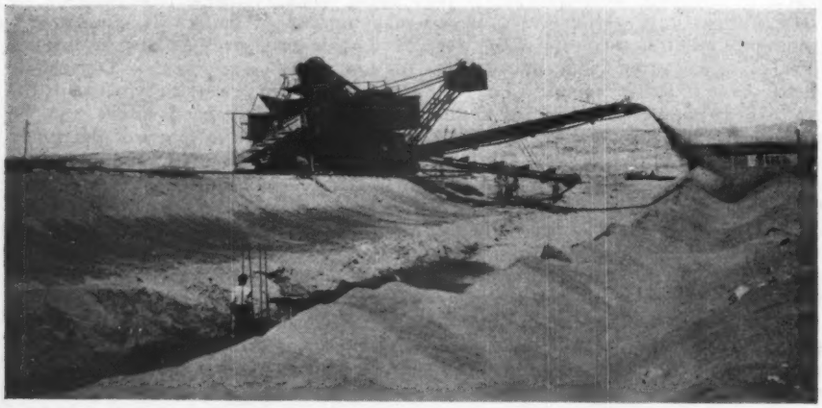
Carbon—the kind used for drilling purposes—is found only in Brazil; it is not formed in layers, but is compact, making it less likely to break. There is a great deal of difference in its hardness, and one way to judge of this is to rub a Brazilian Ballas with a flat side against the carbon. By noting the amount of dust left on the flat side of the Ballas, and by listening carefully to the scratching noise, it is possible to judge of the hardness of the carbon fairly accurately, though the interior may be harder or softer than the exterior. In the hardness scale, 10 represents the diamond, and 9, emery, though it is stated that the real hardness of the diamond is more than a hundred times that of emery.



Courtesy "The Mining and Industrial Magazine of Southern Africa"

Where industrial diamonds are used; diamond drilling for copper at Munshewemba, Rhodesian Congo Border Concession, Ltd.

Shovel at work in the diamond fields of South West Africa



Some stones are so hard that they will do 100 to 1,000 times as much work as other stones. For example, a photograph is shown of a Ballas stone in use by General Motors that has been used for ten years in the Chevrolet plant for such work as truing emery wheels. It does not show much wear and has outlived $200,000 worth of abrasive diamond.

A stabilized market for industrial diamonds as well as gem diamonds is urged: "Before the war, the market for carbons was in Paris, but this was altered. American firms went to Brazil and started bidding against each other. The consumer has to pay for this in the long run, and the use of carbons will decrease. As there are only a few firms in the carbon business, it is regret-

table that there is so little co-operation. . . . Wild price fluctuations are very bad for trade. . . . The price of crushing boart before the war was 4 to 5 shillings per carat, but owing to the shortage that occurred the price rose as high as 16/6 per carat. In 1927 there was a sharp decline to 7/ per carat, the present price being about 8/3 per carat. The position is now much better, and we can look for a steady and improving market in boart and all classes of cheaper diamonds. A firm price for boart of about 10/ per carat would be the best for everybody in the trade."

Mr. Hoover, It Seems, Has Been Preceded

"KNOWLEDGE of divine things for the most part is lost us by incredulity," Plutarch wrote many years ago. Since Mr. Plutarch is generally conceded to be more of an authority on matters of this sort than are we, we must accept this statement as correct. Still, it makes us feel rather disconsolate to know our unhappy fate. For, Mr. Plutarch to the contrary notwithstanding, we are somehow impelled to remain skeptical in the face of the following significant facts, from no less authoritative a source than the American Mining Congress:

"Mr. Hoover, who is the second mining engineer to become President, and who is an honored member of the American Mining Congress, having spoken at several of its recent conventions, retained Secretary of the Treasury Mellon and Secretary of Labor Davis."

The retention of Messrs. Mellon and Davis is accepted as unimpeachable fact and we are even willing to concede Mr. Hoover's membership in the congress, but until a little more elucidation is given as to the identity of the first mining engineer to be President of these United States, we prefer to remain incredulous, even though it means losing the "knowledge of divine things."

Sidelines in Education

AT THE University of Minnesota, it seems, boxing is being given a great deal of attention as a sport, and the *Minnesota Daily* cocks an appraising eye at the monetary returns the ring may hold out for a gentleman of academic culture and training. "Above many other items, boxing holds out to the fortunate men with ability and courage a golden reward that cannot be paralleled in any other line of endeavor today." The Tunney influence, apparently. Mining schools might endeavor to provide means for tiding over the early years of a graduate's apprenticeship by a special course in speculation in the penny shares; or students with a special aptitude for chemistry might find a profitable sideline in the renaturing of denatured alcohol for the trade.

COMMENT AND CRITICISM

Carbonate Filling of Veins

To the Editor of "E.&M.J.":

The articles on "Ore Genesis and Oreshoots," by Professor Carlton D. Hulin, are very interesting. In general, his points seem to be well supported by the facts of observation. Professor Hulin and others have stated that fissure veins were first filled with barren quartz and that this was fractured by later faulting, thereby furnishing channels for the circulation of ore-bearing solutions. Metallic ores were then formed, partly by the replacement of silica by metallic minerals and partly by the deposition of such minerals in open fractures.

There is another step in the process of vein formation that has not been given the consideration it seems to deserve. I refer to the fact that an important proportion of fissure veins were first filled with carbonates and these carbonates were later replaced by silica. In many of the mining districts of the southwestern states where the veins are associated with Tertiary intrusives and volcanics the carbonate filling was predominantly calcite. This is proved by the presence of large masses of residual calcite and pseudomorphs after calcite in the quartz.

In the Cœur d'Alene district most of the important veins were first filled with siderite. This was later more or less completely replaced by barren quartz, and then, during a period of more or less continuous faulting, various metals were deposited in several stages.

The sources of these carbonate fillings are not always easy to find. Limestone is present in some districts, but in others we seem to be limited to igneous rocks as a source of carbonates. Possibly they have no important effect on ore genesis, but it seems to me that any adequate theory of vein formation must take them into account. JOHN B. PLATTS.

Wallace, Idaho.

What Was the Record Blast?

To the Editor of "E.&M.J.":

On page 293 of the Feb. 16, 1929, issue of *Engineering and Mining Journal* reference was made to a large blast to take place at an iron mine. The tonnage to be broken—400,000 tons—was claimed as a record. I suggest that you communicate with the Chile Exploration Company, for information relative to blasts at its open-pit copper mine in Chile. I witnessed one blast there which broke more than 900,000 tons, and know that there were several others between 500,000 and 900,000 tons.

ALAN M. RODGERS.

Columbus, Ohio.

[We are glad to correct the item to which Mr. Rodgers refers. This was entitled "Largest Blast in Mining History Planned at Volunteer," and described a blast that Pickands, Mather & Company is planning to set off in May at the company's Volunteer mine at Palmer, Mich. About 70 tons of explosives will be used, and, according to estimates, about 400,000 tons of ore will be broken by the blast. As mentioned on page 700 of the Oct. 29, 1927, issue of *Engineering and Mining Journal*, the Chile Copper Company is understood to have loosened nearly a million tons at one blast; and at Corona, Calif., about four years ago, it was estimated that two million tons of rock was dislodged when the Blue Diamond Materials Company shot off 180 tons of dynamite.—EDITOR.]

But There Can Be Good Dictators

To the Editor of the "E.&M.J.":

I note with considerable surprise that in the last issue of the *Engineering and Mining Journal*, in referring to Mexican conditions, it is said that "perhaps Mexico needs a Mussolini or Rivera."

Americans in their conceit imagine themselves to be the only people fitted for self-government. Italy has produced several Patrick Henry's in the last few years, who, in the face of certain assassination, have defied Mussolini. A free Italy which I believe is sure to come in a few years will call us to account for such an attitude as this. If the Mexican people are not fitted for self-government they should be encouraged in their attempts to fit themselves. Free public schools with compulsory attendance therein would solve the problem for Mexico in a generation. A dictator could only sit on the lid until there was another eruption. A. RIVETTI.

Parkland, Wash.

[Dictators should be but temporary expedients, but conditions may demand a government of this type until the people can be educated, as Mr. Rivetti says, to appreciate the advantages and to shoulder the responsibility of democratic government. Americans do not consider themselves the only people fitted for self-government: how about the British for example? But Americans do feel that some countries may not be ready for self-government. In this connection, the present policy of the United States government towards the Latin American countries, as exemplified by recent happenings in Nicaragua and Mexico, is of interest. The United States government seeks to aid the existing governments of the smaller countries to enforce order in their respective domains and to add to their prestige. If the existing government is against the best interests of the people they are encouraged to change it by accepted political methods and not by revolution, and the United States stands ready to assist in a friendly way, and so far as it is diplomatically able, in promoting a fair election.—EDITOR.]

Book Reviews

Advice for Youth

THE PROFESSION OF ENGINEERING. *Essays edited by Dugald C. Jackson and W. Paul Jones. John Wiley & Sons, New York. Pp. 124. Price $1.50.*

A COLLECTION of nine essays by seven authors. The first two, by Daniel Webster Mead, are entitled respectively "The Engineer and His Education" and "Success in the Engineering Profession." The next four deal, in order, with civil engineering, mechanical, mining, and electrical engineering, and are from the respective pens of George Fillmore Swain, George Hale Barrus, Robert Peele, and Harold Winthrop Buck. John Hays Hammond contributes essays on "The Electrical Engineer" and "The Chemical Engineer." The volume concludes with President Hoover's speech "The Engineer's Contribution to Modern Life," delivered by him at the A.I.M.E. banquet last year on receiving the award of the Saunders medal. The essays preceding this are likewise reprinted from various sources. These articles, the editors state, have been selected and arranged to form a unified whole, with the intention of giving a broad, non-technical yet detailed conception of the profession of engineering. The book, it is suggested, may be used as a text for freshmen in engineering schools. It may also be studied with profit by the student in his first and second years when he needs aid in choosing between the various branches of engineering. Likewise, it may serve high-school students and parents as a reliable source of information about the engineering profession. For these purposes it is admirably suited. Inspiration and guidance are to be found in its pages. Youth does not always take kindly to advice, but the young man in doubt as to the course he should select, or who is wondering if he has made the proper choice, cannot fail to find help in the wise counsel of these prominent engineers.

The editors suggest, also, that the book may prove useful as a textbook in engineering English courses and that it may be read with profit by the practicing engineer or by anyone who wants a thorough understanding of the engineering profession. These are but secondary purposes, however. It will serve best as a guide to the student and young engineer. A. H. H.

Some New Mineral Districts in Africa

TANGANYIKA GEOLOGY. *Several bulletins published by the Geological Survey Department, Dodoma, Tanganyika Territory.*

THESE are termed "Short Papers Nos. 1, 2 and 3" and are entitled respectively "Outlines of Geology of the Regions Adjoining the Southeastern Shores of Lake Victoria," by F. B. Wade; "Lupa Gold Field," by D. R. Grantham; and "Kigugwe Copper Deposit," by G. M. Stockly. The first of these covers an area between 2 deg. 30 min. south latitude. Geological features are shown over an area of approximately 27,500 square miles. The topography is ancient and the geology of greater antiquity. For the most part the rocks met with are Archaean, the few younger formations being simply denudation products of these old rocks and of comparatively recent origin. The only minerals of economic importance at present known and being exploited in the region are gold and diamonds. The presence of gold-bearing quartz reefs was known and exploited by the Germans before 1914. Other gold discoveries have been made since 1920, when under the present mining laws prospecting was permitted. The most flourishing gold mine before the war was at Sekenke, in the Singida district adjacent to the area under review. There a series of quartz lenses occur as contact veins in a country rock, which is apparently intermediate between a granite and a diorite. Gold is found in the quartz associated with pyrites, a little galena, and no copper minerals. In the area under review the oldest gold mine is the Kilimafeza, "the most easterly outpost of human habitation" in the Musoma district. It is in a belt of schist country, about 5 miles wide, in which the general strike is east-west. No detailed geological work has been done, but five sets of roughly parallel quartz lenses have been found to occur in what has been determined to be a coarse-grained quartz diorite. The gold in the most profitable of these, known as Bonanza reef, is associated with copper minerals in a quartz similar to that of Sekenke. In the other four poorer sets, copper minerals are absent. Several other gold fields occur at distances ranging from 12 to 45 miles.

Diamonds are found near the village of Mabuki, a field discovered prior to the war, but the possibilities of which were realized only in 1925. Since then it has yielded about 10,000 karats of good-sized stones. In these fields the diamonds have originated in a kimberlite, and at present most of the profit has been obtained from the eluvial pebble beds overlying the kimberlite intrusion. No other kimberlite intrusion has been found.

In conclusion, the author states that an extensive area lies open for closer prospecting for gold, and that other kimberlite pipes may be found, as they seldom occur singly; also that with the opening up of the region by a new railway, base metals and minerals may yet prove a commercial possibility.

As for the second paper, the Lupa gold field is in the Rungwe district, about 25 miles northwest of Mbeya. Alluvial gold was discovered in 1923, since when it has produced about 32,800 oz. of gold. Presence of this alluvial gold indicates the probability of finding payable reefs. Two features of the field are pointed out as worth mentioning—namely, the very close resemblance to certain of the auriferous areas of Rhodesia; and the fact that the quartz reefs are of such extent and persistence that there should be little doubt of their continuance in depth, although the value can be determined only by systematic opening up. There is every prospect that this may be done immediately.

The Kigugwe copper deposit, mentioned in the third paper, is in the region of the mountain of Cha-Fukwa, about 10 miles from the Tuyuku road between Buhora and Brandt's, although to a person 10,000 miles away without a map this is not a very informative statement. The copper occurs as irregularly shaped nodules of chalcocite with an envelope of secondary carbonates of malachite and azurite, the latter being a relatively rare occurrence. These nodules are found sporadically in a greenish bleached shale appearing to have no connection either with bedding, joints or faulting. Each nodule appears to have originated *in situ*, the laminæ of the shale being crushed and pushed aside. The chalcocite is apparently primary. Ten boreholes were completed, with one exception at a depth of between 200 and 300 ft. Another occurrence, hitherto unpublished, has been found close to the junction of the Numbi and Ripera rivers near the village of Salimwani, about 8 miles west of Kigugwe.

Accompanying the three papers is the Geological Survey's Annual Report for 1927. This is published by the Crown Agents for the Colonies at 4 Millbank, London, S.W.I., England. The price is 5s.

MATHEMATICAL TABLES AND FORMULAS. *By Percey F. Smith and William Raymond Longley. John Wiley & Sons, New York. Pp. 66. Price $1.60.*

THIS collection of tables and formulas is intended primarily as a handbook for solving numerical problems in connection with the courses in mathematics of the freshmen and sophomore years in colleges and technical schools, according to a statement by the authors in their preface. It is expected to be useful also to workers in any field requiring application of the calculus.

Personal Notes

Charles A. Mette's address is wanted.

Samuel H. Dolbear and **Kenneth M. Simpson** have been elected directors of Mineral Research Corporation.

R. M. Johnson, recently with the Southern Rhodesia Base Metal Corporation, is visiting in San Francisco.

Colonel **William Boyce Thompson,** Dr. **William Vogler,** and **Fred Searles** are visiting the Magma mine, at Superior, Ariz.

Percy Cropper, for many years editor of the Salt Lake *Herald,* has been appointed mining editor of the San Francisco *Bulletin.*

Gordon R. Campbell, of Calumet, president of Calumet & Arizona, and Mrs. Campbell are visiting Bisbee, where the company's mines are located.

Clarence Logan, district engineer of the California State Division of Mines, is investigating mines and mineral resources of Sierra County, Calif.

Charles Sutro, of San Francisco, has resigned as president of Katherine Gold Mining. **R. L. Dimmick,** superintendent of the property, has also resigned from the company.

W. E. Chancellor, of Cerro de Pasco; **E. L. Graham,** of Guggenheim Brothers; and **O. L. Vold,** of Chile Exploration, sailed for Chile on the "Santa Barbara" recently.

E. M. Campbell, of Perth, Ont., formerly connected with the Canadian Geological Survey, has returned to his home after a visit to the mining districts of Nova Scotia.

Cyril W. Knight, mining engineer, is now making an examination of the Dunkin Gold Mines property, in the Narrow Lake section, Patricia district, northern Ontario.

Paul Linz, of the metals sales department of the American Metal Company, sailed from New York on the "Conte Grande" for southern Europe on March 16. He expects to be gone about eight weeks.

Samuel Shapira, mining engineer, of Boston, has returned to Russia to renew his engagement by Stuart, James & Cooke, technical advisers to the Soviet government. His work will be principally on coal and iron.

W. D. Abel, chief mining engineer of the California State Corporation Department, recently addressed the mineral section of the Commonwealth Club of California on interesting cases presented to the corporation department.

George W. Crowe, of Long Beach, Calif., recently examined properties in the Payson district, Arizona, and the Altar district, Sonora, Mexico, for the Wishon Mining Corporation, of Kingman, Ariz., and Los Angeles.

Phillip Billinghurst, mining engineer and geologist, who has been engaged in lode and placer mining of tin in Burma for several years, has been engaged by Manitoba Tin to investigate the occurrences of tin in the Shatford Lake district, Manitoba.

C. W. Wright, chief of the mining division of the U. S. Bureau of Mines, sailed from New York on the "Leviathan" on March 20 for Italy, where he has mining interests. He expects to return to Washington about April 15.

W. C. Page, who is in charge of the concentration work at the Roan Antelope mine, in Northern Rhodesia, arrived in New York from London on March 13. He expects to spend the next six or eight weeks traveling through the

Blank & Stoller

W. C. PAGE

West and Southwest to inform himself as to improvements in methods and equipment for treating copper ore that have been made during the last two years, after which he will return to London. He will be accompanied on his Western trip by **H. D. Bemis,** of the American Metal Company, whom he will meet in Denver. Two years ago Mr. Page was engaged by **A. G. McGregor** for the Roan Antelope company to take charge of the work at its pilot plant. Following the completion of this work in Rhodesia he is working in London with Mr. McGregor on the design of the concentrator to be erected on the Roan Antelope property.

C. F. Jackson, of the mining division, U. S. Bureau of Mines, has recently completed a trip through the iron-mining districts in Michigan and Minnesota, where he conferred with operators and engineers on the preparation of several papers on mining methods and costs.

C. H. White is now in eastern Northern Rhodesia, in charge of exploration work for Russo-Asiatic Consolidated, which has been granted exclusive prospecting rights on the North Charterland concession in that section of the country. He is accompanied by **Donald Gill.**

John Wellington Finch, consulting mining engineer, of Denver, and special lecturer in geology at the Colorado School of Mines, is in New York City, serving as an expert witness for the government in its case against officials of Canario Copper for using the mails with intent to defraud.

H. Foster Bain, secretary of the A.I.M.E., is sailing on March 27, for Colombia, South America, to serve as a consultant to the Colombian government in the consideration of a revision of the petroleum mining laws of that country. Mr. Bain will be accompanied by **J. W. Steele,** of the leasing service of the U. S. Geological Survey, Casper, Wyo., and **Jose Anador Ibarra,** petroleum engineer of Mexico and Oklahoma, who will serve as his assistants. **M. W. von Bernewitz,** has been granted a leave of absence from his duties at the Pittsburgh station of the U. S. Bureau of Mines to assist in the executive direction of the Institute during Mr. Bain's absence.

OBITUARY

Frank V. Marsden, mining engineer, died at London, Ont., on March 11, following a long illness. He had been engaged in mining in northern Ontario for many years.

George W. Morgan, vice-president of New Quincy Mining, in the Park City district of Utah, died at the age of 65 in Salt Lake City recently, following an operation for hernia. He was born in New York, and went to Butte, Mont., in 1887. Since that time he had lived in Western mining camps and was interested in several mining ventures.

Louis Terah Haggin, former president of the Cerro de Pasco Copper Corporation and director of the American Metal Company, died on March 19 in his home, in New York City, after a lingering illness which developed into pneumonia on Saturday. He was the son of James B. Haggin, one of California's pioneers and business leaders. Mr. Haggin was born Nov. 22, 1847, at Natchez, Miss. Educated in England, he was graduated from St. John's College, Cambridge, in 1870 with an A.B. degree. Two years later he received his degree of LL.B. from the Harvard Law School and was soon admitted to the practice of the law in San Francisco. In 1873 he married Blanche Butterworth, of New York. His father was active in many mining enterprises almost until his death at the age of 92, and soon the son acquired an interest in corporation finance. His business connections, eventually diverting his attention from the law, brought him to New York.

William Orr, among the last of the pioneers of the mining industry in Australia, died in Melbourne recently. He was born in Ayrshire, Scotland, in 1843, and after arrival in Victoria went, with his father, to the Castlemaine and Daylesford districts while the early gold boom in that state was at its height. Mr. Orr's interests were connected with several gold mines in Victoria, as well as with the first flotation of silver-lead ventures at Broken Hill, in New South Wales. Later, with two others, he undertook the development of the Mount Lyell mine, Tasmania. For some time he was on the Gympie gold field, in Queensland, and owned several claims there. In subsequent years the principal venture with which Mr. Orr was connected was the Hampden-Cloncurry copper mine, North Queensland, now in liquidation. His latest connection with mining was as the holder of a small interest in the Mount Isa company, in the same district.

NEWS OF THE WEEK

Summary

MICHIGAN copper producers are now operating at capacity. Output will probably decline in summer, when labor becomes scarce. Quincy and Seneca not expected to produce on large scale till next Fall. Page 494.

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Canam Metals has taken over on option all the properties of Cortez-King Brand Mining, in the Tri-State district. Option is of four months' duration. Page 493.

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Lacking funds for adequate research in the field of geophysics, the Bureau of Mines will publish results of studies by other agencies, in the United States and abroad. Page 496.

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Reopening of the famous Porphyry Dyke gold mine, near Rimini, Mont., is being undertaken. The property is equipped with a 500-ton mill for the treatment of low-grade ore. Page 497.

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Ardsley Butte Mines, in the southwest part of the Butte district, will build a 150-ton concentrator at its Ardsley mine to treat low-grade lead-zinc-silver ore. Page 497.

* * *

Cliff Mining will continue the exploration program at its property in Keweenaw County, Mich., which was begun two years ago. Page 494.

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Whitedelf Mining expects to start milling ore from its mine at Clark Fork, Idaho, in May. Construction of the new concentrator at the property has proceeded rapidly in spite of the weather. Page 495.

* * *

For the second week in March, output of zinc concentrate in the Tri-State district was the greatest in more than a year. With the close of the winter, practically all the tailing mills are again in operation. Page 493.

Two New Blocks of Land Near Sudbury Acquired by Important Mining Groups

Lindsley Interests and Mining Corporation Purchase Large Tracts of Ground and Prepare for Development—Sudbury Basin Will Continue Drilling at Vermilion Lake Property

TWO important Canadian mining groups—Mining Corporation and the Lindsley interests—have purchased large amounts of ground in the Sudbury district and are preparing for intensive development. The Lindsley interests, which already control a promising nickel prospect in Falconbridge Nickel, have acquired another nickel property in the Strathcona mine. This adjoins the Levack mine, from which Mond Nickel obtained a large part of its production and which is now being operated by International Nickel of Canada. Sudbury Basin Mines & Ventures, Ltd., are the Lindsley companies involved in this deal.

The Strathcona mine will be operated by Sudbury Nickel-Copper. On the Bothwell claims, 29 ft. of ore was cut by a diamond-drill hole recently. Of this 9 ft. averaged 4 per cent combined nickel-copper.

Sudbury Basin is also continuing its drilling on the Vermilion Lake property, adjoining the Errington mine of Treadwell Yukon. The orebody has now been proved for a length of 1,500 ft., and drilling is estimated to have shown about 2,000,000 tons. An intensive diamond-drilling campaign is now proposed over a total length of 3,000 ft. Average width of the ore zone, as indicated by the drills, is 40 to 50 ft., usually in two or three sections. Average grade is reported to be higher than for any body of corresponding size in the Errington mine.

Mining Corporation has acquired an 80 per cent interest in various blocks of ground in the Sudbury district, embracing a total of 232 claims and covering approximately 9,000 acres. These claims have been selected over a considerable period of time and cover strategic points along the contact zone. A start on exploratory work will be made this spring as soon as favorable conditions exist.

Trading in Mining Corporation shares has been unusually active on the Toronto exchange recently because of the variety of its holdings. It has, in addition to these Sudbury claims and its original mines in the Cobalt district, the Murray property adjoining the Noranda mine, in Quebec; a 35 per cent interest in Base Metals, the new company formed to develop the Monarch property in British Columbia; and a large share interest in Hudson Bay Mining & Smelting.

A new company, called Quemont Mining Corporation, has been formed to take over the Murray property, in Quebec, where the shaft is being sunk to 975 ft.—the depth at which the famous "H" orebody was discovered on the adjoining Noranda mine. Shareholders in Mining Corporation have been offered the right to subscribe for one share of Quemont at $1 a share for each five shares of Mining Corporation held. Quemont has an authorized capital of 2,000,000 shares, of which 1,000,000 were issued for the property and 133,592 shares were issued at $1 each to carry on development. Mining Corporation subscribed for enough of this stock to enable sinking the shaft to 600 ft., at which depth it is now bottomed.

Underground work on the 200 level of the property showed a short lens of copper pyrite in the mineralized rhyolite, which carries some gold. This rhyolite extends into Noranda territory and in it some orebodies have been developed by that company. Although no material sufficiently valuable to be classified as ore has yet been found, the favorable position of the ground and the geological structure are said to afford good prospects of developing orebodies at depth. This property was formerly developed by United Verde Extension, of Arizona.

Nineteen Deaths Occurred in Missouri Mines in 1928

Coal and metal mines of Missouri recorded nineteen fatal accidents, eleven in the coal mines and eight in the metal mines, in 1928, according to a report just issued by Frank Fenix, of Joplin, state mine inspector. The fatalities in the metal mines were equally divided between the southeast and southwest mining fields.

Mexican Mining Districts Hampered by Lack of Supplies, Due to Revolution

MEXICO CITY, March 10, 1929.—The revolt of several Mexican generals is causing considerable annoyance to mine operators in certain sections of Mexico because of the increasing inability to secure transportation for supplies in, and ores out, as well as making it difficult in those sections to transfer funds for the payrolls. The A. S. & R. and Peñoles smelters will be seriously affected unless the rebellion is put down in territories from which they draw their ores. The principal territories threatened are several portions of Chihuahua, Jalisco, and Zacatecas. Sonora districts, at this writing, are operating normally, but there has been no fighting there thus far. Most of the larger camps have laid in supplies for some time in advance. Pachuca claims to be stocked for three months with all necessary materials. Independent concerns in remote districts will suffer most because of lack of transportation if the rebellion is not put down promptly.

Reports from Guanajuato state that Guanajuato Reduction & Mines is considering closing because of the recent kidnaping and assassination of two of the company's employees by bandits. The federal troops, however, were very prompt in overtaking and executing those principally engaged in the raid.

A group of Chicago capitalists, already heavily interested in the mining camp of Asientos, is reported to have signed a contract with the state government of Aguascalientes for a number of important works. Among them is the construction of an electric plant at San Gil, for transmission of electric current to the mining camp of Tepezala, and the construction of a railway between the mines at San Antonio and El Cobre. The company obligates itself under the contract to employ not less than 600 day laborers or miners and expects to spend more than $1,000,000 in the various enterprises.

A. C. Villasenor, president of the Chihuahua Mining Chamber, is in this vicinity representing about 500 small miners in Chihuahua, who are urging an early change in the present mining legislation. Petitions of a similar nature have also been sent in from various states of the interior, but probably no immediate action will be taken.

According to the law which fixed the 1929 national budget, a new project for import tariffs is under consideration and will probably be put in effect within the next few weeks. It will include, among other things, the present consular invoice charges and import duties plus the 10 per cent surtax. How much of an increase mining interests may be called upon to stand, is not yet known, but it may be taken for granted that there will be an increase, despite the clamor for reductions.

Airplanes are being pressed into service for transporting funds for payrolls in several of the larger mining camps in the zones possessed temporarily by the rebels, where train equipment has been largely commandeered by one side or the other for the transportation of troops or supplies.

Canam Metals Options Mines of Cortez-King Brand

JOPLIN, Mo., March 19.—Canam Metals, the company that recently purchased five mines of the Childress Lead & Zinc Company for $1,000,000, has taken an option on the properties of the Cortez-King Brand Mining Corporation, in the Tri-State mining district. Clement K. Quinn, of Duluth, Minn., and associates are back of Canam Metals. Although no price consideration has been made public, the amount involved is understood to exceed that given for the Childress properties. The mines and leases included in the option are the New York, Cortez-King Brand, Jeff City, Sonny Boy, Liza Jane, Opperman, Missouri Mule, and miscellaneous holdings.

R. S. Archibald, of Negaunee, Mich., vice-president of Canam Metals, represented Mr. Quinn in this transaction. C. W. Nicholson, who is in charge of the company's local holdings, will act in a consulting position with Cortez-King Brand during the term of option, which is four months. All profits accruing during the option will go to the purchasing company if the option is exercised.

At present the Cortez-King properties are owned by a group consisting of Cortez Enloe, H. B. Church, Sam Baker, former Governor of Missouri, and other residents of Jefferson City, Mo. W. T. Landrum, of Baxter Springs, Kan., is manager of the company.

New Shaft Will Be Sunk at the Old Gwin Mine

THE first carload of machinery for the Gwin mine, which is being reopened by T. Leonard Park, Jeffrey Schweitzer, and J. J. McSorley, has been received at Valley Spring, Calif., according to Mr. McSorley. This mine was closed in 1908, after being operated for many years, because of a dispute with the company supplying power.

The program of the present operators is to sink a new vertical shaft in the eastern part of the property. This shaft is expected to cut the main vein at a depth of about 4,000 ft. Records of the old company show about 240,000 tons of ore blocked out, with additional tonnage available, but not blocked. Work has been started in the Oneto tunnel, north of the Gwin, and some new ore has been struck. The Gwin mine, with the Oneto and other properties to be included, covers about 1,000 acres on the Mother Lode belt. The mine is in Calaveras County, Calif., 4 miles west of the town of Mokelumne Hill.

Development of the Gwin property previous to its closing down included a 2,400-ft. vertical shaft and a 450-ft. winze below that level. Its production is reported to have been about $5,000,000 in gold from ore averaging $5 a ton.

Tri-State Output Reaches Largest Total of Year

ZINC concentrate production in the Tri-State district reached the 13,000-ton mark in the second week of March for the first time in more than a year. The rapid increase in output is worrying the producers of the district, as smelters, agents claim that the demand for concentrate in the weeks to come will not equal the output. For the first time during the year the new sales agency had more zinc for sale than it was able to dispose of. Some of the mines not allied with the agency have also found it difficult to place their production.

Practically all of the tailing mills that were forced to close during the severe winter weather have again resumed production. The output of float ore has increased from 1,500 tons a week to more than 2,700 tons within the last few weeks, and this grade of concentrate has again become a drug on the market.

Another American Mining Engineer Is Kidnaped

T. L. Carnahan, mining engineer, of El Paso, Tex., who was in charge of operations at the La Noria mine, in Zacatecas, was knidnaped by Mexican bandits on March 18, and is presumably being held for ransom. Mr. Carnahan had returned to the mine from El Paso only about two weeks ago.

In this connection, a letter received from L. D. Huntoon on March 20, should be of interest. He says: "Was not captured by bandits. Reached here (Mazatlan, Sinaloa) on last freight train for steamer leaving on March 13 for San Francisco. Town being entrenched. Cemetery with rifle holes in wall last stand for federals."

Mountain Copper Mill Is Moved to No. 8 Mine.

Mountain Copper Company is moving its concentrator from the Iron Mountain mine to the No. 8 mine, in Shasta County, Calif. This property has been reopened and is now employing about 100 men. Production will be started when the mill is ready for operation. The company is also considering plans for the construction of a cyanide leaching plant for the treatment of low-grade gossan ore.

New Hoist in Operation at Basin Montana Property

INSTALLATION of the new 50-hp. Vulcan hoist at the collar of the winze in the south tunnel of the Grey Eagle mine of Basin Montana Tunnel, near Basin, Mont., has been completed and it is now in operation. The timber in the winze has been repaired and new guides have been installed. Three shifts are now working east of the bottom of the winze to tap a body of lead-zinc-sliver ore. According to records of past operations, this orebody should be struck about 50 ft. east of the winze.

Water is being handled by a No. 7 Knowles sinking pump, which is being operated by air. The south tunnel at the porperty is now open to a point 250 ft. east of the winze and is within a short distance of what is known as the first Freeburg orebody.

Utah-Apex Miners Being Trained in First-Aid Work

THE U. S. Bureau of Mines recently finished training one of the largest first-aid classes ever trained. It was composed of about 300 employees of the Utah-Apex mine, in Bingham Canyon, Utah. A. R. Kessler, foreman miner of the Bureau, and C. A. Bonner, safety engineer of Utah-Apex Mining, were in charge of the work. The class included about half of the total working force at the mine. The other half is now being instructed. Utah-Apex will be one of the first mining companies in the country to have 100 per cent of its employees trained in first-aid work.

A large number of men is also being trained in mine rescue work. Utah-Apex has accomplished a great deal in accident prevention work in the last year, having reduced its accident rate about 50 per cent, under the direction of Mr. Bonner and J. A. Norden, manager of the company.

Zinc Institute May Establish Research Department

ESTABLISHMENT of a research fund and department of the American Zinc Institute will probably be the main topic for discussion at the eleventh annual meeting of the organization to be held at St. Louis, Mo., April 15, 16, and 17.

The zinc industry has been more or less stabilized under the direction of R. M. Roosevelt, president of the Institute, but in the stabilization process the greater proportion of the producers of zinc concentrates and metal have had to reduce capacities and outputs to a point where the margin of profit is small. The promulgation of a research campaign will, it is thought, tend to increase the consumption of zinc to a point where the productive capacities can be further maintained. Increased consumption, without entailing enlarged investments, naturally would be likely to lower costs and increase profits.

Michigan Copper Producers Are Now Operating at Peak Capacity

CALUMET & HECLA, Isle Royale, Mohawk and Copper Range, the principal producers in the Michigan copper district, which are operating practically at peak capacity now, will be fortunate if they are able to maintain present rate of output during the late spring and summer, when a considerable labor exodus takes place. The farms take their quota of men, and others leave to take seasonable surface occupations. No matter to what price copper goes, little likelihood of production increase exists. Quincy and Seneca will not become important factors as producers until later in the year. At Calumet & Hecla, five shafts on the Osceola lode are producing, leaving only a development unit idle. Through selection, yield from the Osceola lode has been brought up to a general average of 20 lb. of copper or better per ton. The minimum at one time in former years was 11½ lb., without any particular selection. Even more liberal selection in the Osceola may be possible, owing to the extensive acreage on the strike of the vein.

No. 3 North Tamarack shaft will probably be the supply shaft for all new work in the north end of the company's conglomerate department. No. 12 will be the supply shaft at the south end. Use of No. 3 for this purpose at the north indicates that the north end will become an important part of the conglomerate operations. Conglomerate reserves in the older sections of the property are good for many years to come. In addition to the opening of virgin ground below the No. 81 haulage tunnel in the Hecla and Calumet departments, pillar and arch mining above the 81st is yielding good ore.

The Kearsarge amygdaloid bed has been opened between North Kearsarge and Centennial, the No. 43 level drift from No. 1 North Kearsarge having been driven into Centennial ground. One of the Centennial shafts, now being dewatered, will be explored from the bottom. Probably six months longer will be required to drain this shaft. Time and expense are required to reopen mines long idle. In addition to draining, the cost of shaft and equipment repairs is considerable.

Copper is moving steadily out of the Michigan district. All companies have sold their output beyond June. Not all orders for future delivery are being accepted.

Exploration at Cliff Mine Will Be Continued

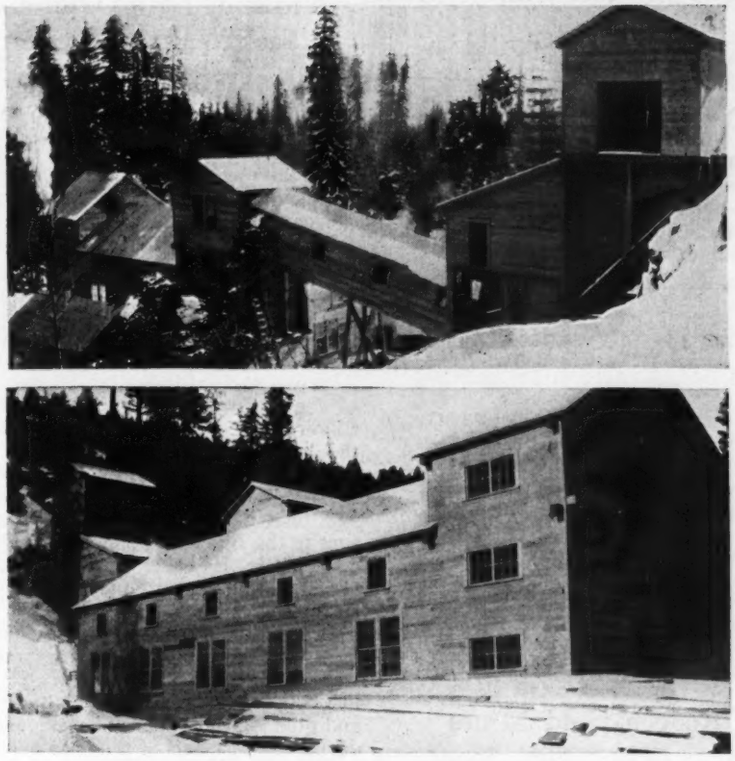
AFTER two years of preliminary work, which was required to restore the property and secure further geological information, R. L. Agassiz, president of the Cliff Mining, in the Michigan district, announces that the company is ready to carry out energetically the program which was announced two years ago. At that time it was stated that the results of geological studies pointed to certain specific areas of outstanding attractiveness, one of which was to be investigated in the current Cliff exploration. In the two years which have elapsed, further studies have borne out the wisdom of this decision.

During 1928, the old Cliff fissure workings were unwatered from an elevation of 230 ft. below the No. 13 level to the bottom of the old mine. No. 4 shaft was repaired throughout, and the old No. 20 level drift, after being cleared of débris, was enlarged and track laid to a point 1,500 ft. from No. 4 shaft. Geological studies indicated that possibly the old workings from No. 17 to No. 20 level were not on the main fissure. A drift was driven westward along an amygdaloid which crosses the old fissure drift, 850 ft. northwest of No. 4 shaft. Several fissures were encountered, one showing rather strong mineralization. A diamond-drill hole was also started from a point on the No. 20 level 1,500 ft. northwest of No. 4 shaft.

The Cliff fissure was discovered more than 80 years ago and furnished the copper for the first real mine in the district. The mine was worked for 40 years and then was abandoned and allowed to fill with water. For more than 40 years it has been idle. During the last two years the company has unwatered this mine; repaired two shafts 900 and 1,600 ft. deep, respectively; reclaimed and retimbered the No. 13 level drift connecting them; installed suitable pumping equipment; and finally reopened the old bottom level for 1,500 ft., which practically meant driving a new drift, as the old one was badly crushed and caved and too small for modern practice.

Work Has Been Started at North Butte Property

MINERS are now at work in the Granite Mountain mine of North Butte Mining, in the Butte district of Montana, and ore shipments are expected to start about the end of March. The company is also unwatering its Main Range property in the eastern part of the Butte district. According to Paul A. Gow, president and general manager, all the receivership proceedings have been eliminated and the company has more than $1,000,000 in cash for working capital, after payment of all debts. Stockholders of record March 23 will be entitled to vote at the annual meeting, which will take place at 615 Pioneer Building, St. Paul, Minn., on April 15.



Two views of the new flotation mill being built for Whitedelf Mining & Development at Clark Fork, Idaho

Expect to Start New Mill at Whitedelf in May

MACHINERY for the new flotation plant being built by Whitedelf Mining, in the Clark Fork district, Idaho, is now being installed, and the company expects to start operations early in May, according to Compton I. White, manager of the property. The plant will have a capacity of 75 tons of silver-lead ore daily, but it has been built so as to permit addition of an extra unit at comparatively low cost. W. L. Zeigler, metallurgical engineer, of Wallace, Idaho, has been in charge of construction work, which started in December.

Although the weather has been unprecedentedly cold, construction work has been pushed steadily. A large boiler was used to furnish hot water and steam to protect the concrete and thaw the frost to a depth of 4 ft. in places where excavations were found necessary. The management resorted to the practice used by placer miners in the Klondike gold district. A series of holes was drilled into the frozen ground and hot water was turned on. This was found more efficient than turning steam on the ground under cover.

During construction of the mill, shipments from the mine to the East Helena smelter of American Smelting have been continued. The mine superintendent has estimated sufficient ore above the tunnel level for a year's production. In addition, development work is being carried on below the tunnel level to a depth of 250 ft.

Spokane Banquet on March 11 Was Well Attended

F. W. BRADLEY, of San Francisco, recently elected president of the A.I.M.E., was the chief speaker at the annual mining banquet in Spokane on March 11. This banquet was held under the auspices of the Northwest Mining Association, the Columbia Section of the A.I.M.E., and the mining bureau of the Spokane Chamber of Commerce. It was held in the Davenport Hotel and was well attended by mining men and their wives. Frank M. Smith, smelter director of Bunker Hill & Sullivan, presided.

One of the features of the evening was the showing of motion pictures of the recent excursion of 300 mining men to the Metaline Falls district and also of activities at the Morning mine, of Federal Mining & Smelting, in the Coeur d'Alene district, Idaho.

Mr. Bradley, in his address, compared the aims of the Canadian and American Institutes, meetings of both of which he had just attended. The aims of both institutes are to promote all of the arts and sciences pertaining to mining, he said, but the American organization does it from the professional point of view, whereas the Canadian does it from the industrial. Mr. Bradley said that the meeting of the Western division of the American Mining Congress in Spokane next fall should be a great impetus to mining in the Pacific Northwest, and he particularly urged that mining engineers in western Canada be invited to attend.

Among the other speakers was Lewis P. Larsen, president of the Pend Oreille Lead & Zinc, who pointed out that several years ago the managements of the big Coeur d'Alene mines could not be made to admit that there was any zinc in their mines, whereas now that the Sullivan electrolytic zinc plant was in operation, and the zinc content of their ores thus rendered valuable, they were extremely proud of it. Stanly A. Easton, manager of Bunker Hill & Sullivan, spoke of the new zinc plant in considerable detail and paid a tribute to the metallurgical work of U. C. Tainton, who designed it. Mr. Tainton was present and was introduced to the meeting.

Dr. F. A. Thomson, of the Montana State School of Mines, spoke of the remarkable achievements of Alaska Juneau, of which Mr. Bradley is president. This property is now mining and milling its ore for 63c. a ton, and making a profit. The importance of the mining industry to Spokane was pointed out by N. W. Durham, contributing editor to the Spokane *Spokesman-Review*. Had it not been for mining, he declared, Spokane, instead of being a city of 120,000 people, would not have more than a third of its present population.

United States Senator C. C. Dill was present, and said that he has always fought the tendency of the department bureaus in Washington to extend federal control into a great many industries, and that he has particularly striven to keep mining free from such control. B. H. Kizer, president of the Spokane Chamber of Commerce, commented on the fact that mining is not necessarily as hazardous as most people believed it, and pointed out the stability of such an enterprise as Bunker Hill & Sullivan.

May Build Railroad to Spruce Mountain District

A bill has been introduced into the Nevada State Legislature which will grant right-of-way for the construction of a railroad from Tobar, in Elko County, on the Western Pacific Railway, to the Spruce Mountain district, a distance of 17 miles. The Missouri Monarch Mines company was recently organized by Duncan MacVichie to develop the Spruce Monarch mine. A bunkhouse has been built and sinking of the underground shaft started.

Silver Shield Reopens Mines

Preparations are being made at the Copper Jacket and Flying Dutchman properties of the Silver Shield Mining & Milling Company to work the copper deposits associated with a limestone-monzonite contact. Nearest shipping point is Jericho, Utah, on the Union Pacific Railroad, 20 miles away. The property has been developed by four shafts. Operations will be carried on from the Copper Jacket shaft, where a gasoline hoist and compressor have been installed.

Bureau of Mines to Publish Outside Data on Geophysics

By Paul Wooton
Special Washington Correspondent

DENIED an opportunity to do much geophysical research of its own through the failure of Congress to provide funds for the purpose, the U. S. Bureau of Mines is planning to publish such results as it can obtain from the many agencies here and abroad that are working on this problem. In this connection C. W. Wright, the chief engineer of the Bureau's mining division, points out that the electrical and building industries are much interested in these studies. Commenting on the plans of the Bureau in this connection, Mr. Wright says:

"The value of applied geophysics to industry has stimulated individuals and corporations to do a large amount of research work, the results of which are now being published both here and abroad by technical societies and institutions. The Bureau of Mines will make these results generally available through the co-operation and help of prominent geophysicists who will act as associate editors in the preparation of abstracts of published material on this subject. Interesting articles appearing in the Russian and Japanese languages will be included in these abstracts.

"Translations from the Bulletin of the Institute of Practical Geophysics at Leningrad will be made. These abstracts and translations will be issued in the form of Bureau of Mines information circulars.

"A large amount of research work is necessary because of the many new problems arising and the difficulties encountered in the classification and interpretation of the various ground reactions. Development of methods for the measurement of constants needed in the various geophysical methods is receiving careful attention by the Bureau of Mines. The determination of such constants is work that many educational institutions might undertake, and the Bureau will be glad to co-operate in such work.

"The Bureau is primarily interested in geophysics as applied to the location of mineral deposits, but it is not unmindful of the value of such investigations in other branches of industry. Location of suitably conducting ground is of great economic interest to the electrical industry. The interference between power lines and communication systems depends largely upon the conductivity characteristics of the ground. Geophysical methods apply to the study of subsoil and to foundation work which is of direct concern to building contractors. The Bureau of Mines endeavors to keep informed of new uses and to be of assistance in the extension of the field of usefulness of geophysical methods."

Dr. F. W. Lee is in charge of this work for the Bureau of Mines, much of which is being carried on through co-operative arrangements with geophysicists and interested institutions.

Will Dredge Old California Townsite

A DREDGE is under construction for Lancha Plana Gold Dredging, which intends to dredge the site of the old mining town of Lancha Plana, in Amador County, Calif. Operations are expected to start in August.

Strike High-Grade Gold Ore in Southeastern Manitoba

At the Gem Lake Mines property, in southeastern Manitoba, a high-grade orebody has been developed on the 250 level. This ore has been drifted on for a length of 130 ft., of which the last 80 ft. is high-grade material. The width is about 42 in. A new mining plant is being installed, which is naturally hindering development work at present, but within six weeks the management expects to be using three drills for development work.

Reopen Gold Mines Near Deer Lodge, Mont.

Operations will be resumed at the Emery and Blue-Eyed Maggie mines, in the Emery district, near Deer Lodge, Mont. These properties have recently been taken over by North American Mining & Smelting. The Emery mine has developed a large body of low-grade gold ore, and is equipped with a 100-ton flotation plant that was built in 1917. Development is by two shafts, one 1,400-ft. incline shaft and one 450-ft. vertical shaft.

Childress Buys Acme Mine

Frank Childress has purchased the Acme mine, southeast of Picher, Okla., in the Tri-State district, from J. R. and C. C. Cole, of Tulsa, Okla. The consideration was not made public. The Acme mine has been a large producer of zinc and lead in the last few years. Mr. Childress recently sold five mines of the Childress Lead-Zinc Company to Canam Metals, Ltd., for a consideration exceeding $1,000,000. It is understood that he is contemplating buying one or two other mines.

Operations to Be Resumed at New Dominion Mine

Operations will be resumed at the New Dominion Copper mine, in the Globe district of Arizona, according to E. W. Mitchell, president of the company. The property adjoins the Old Dominion mine on the north and the Iron Cap and Big Johnnie mines on the south and east. It has been closed since March, 1925. Development includes a shaft 1,200 ft. deep, with levels at 125, 200, 460, 800, 1,000 and 1,200 ft.

Nipissing Drops Option on Jack Waite Properties

NIPISSING MINING has dropped its option on the mine and mill of Jack Waite Consolidated, in the eastern part of the Coeur d'Alene district, Idaho, according to the New York offices of the company. W. L. Heidenreich, E. V. Neelands, and James Crowe, engineers for the company, recently visited the property. The present management of Jack Waite will continue development work, however. The main tunnel will be continued 1,500 ft., according to M. L. Savage, manager of the company. This is expected to strike the extension of the surface showing of ore on the Silver King claim about 480 ft. below the surface.

Operations are being maintained at the usual rate, the mill handling about 120 tons a day. Lead concentrate is sent to the Bunker Hill smelter and zinc concentrate is being stored. An increase in mill capacity may be made this spring.

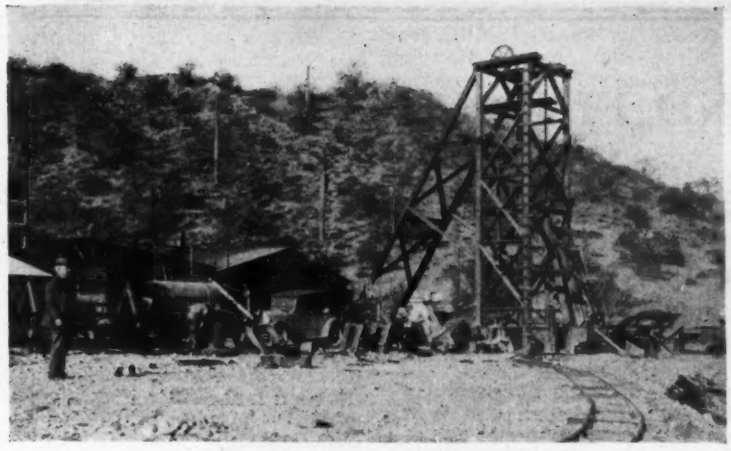
Production of the property during 1928, from ore shipped to the smelter, was: lead, 2,068,626 lb.; zinc, 250,197 lb.; copper, 10,369 lb.; silver, 8,325 oz.; and gold, 43 oz. The mill was operated during the last half of the year only and several interruptions occurred during that period.

Coniaurum Mines Goes Into Receivership

CONIAURUM MINES, LTD., operating in the Porcupine district, northern Ontario, has been put into receivership. On the application of the Toronto General Trust Corporation, trustee for the bondholders, the Court appointed Fraser D. Reid, manager of the company, as receiver, with authority to carry on the business and to borrow sums up to $50,000, if necessary, with which to proceed, and to give a bond for $25,000, if so ordered. Alexander Longwell, one of the directors, stated that the mine had been producing regularly and that the 500-ton mill is now operating, but that returns were not sufficient to carry on development work. Mr. Longwell does not believe that the receivership will result in ceasing operations.

East Helena Raises Wages

At the East Helena lead smelter of A. S. & R., wages have been raised 25c. per shift. This makes the average wage about $4.50 per shift. This is the first announcement of a wage increase at a lead plant in the Northwest, and it probably results from necessity of keeping experienced smeltermen from leaving to seek work at copper smelters, where wages have been raised three times because of the increases in the price of copper. At the lead smelters in the Salt Lake Valley, wages have been raised, but most of those plants treat copper as well.



Main shaft at Montizona Copper

Montizona Copper Working Three Shifts on Development

OPERATIONS on a three-shift basis are in progress at the property of Montizona Copper, in the Sheridan district, Pima County, Ariz., according to a recent statement issued by M. W. Bacon, president of the company. An operating force of 24 men is employed. Current underground operations are confined to the sinking of a vertical winze from the 900 to the 1,300 level at a point 600 ft. east of the main shaft. Following the completion of this work the main shaft will be deepened from the 900 to the 1,300 level and connecting workings will be driven from the winze to the shaft. The property comprises about 1,300 acres, the greater part of which consists of patented claims. Development includes an 830-ft. adit, a 280-ft. incline shaft, and a 400-ft. vertical shaft.

Four Applications Made for Power for Mining Purposes

THE Federal Power Commission has received four applications for hydroelectric power developments, which will be used to further mining operations in Montana, Colorado, Arizona, and Oregon. The following applications have been made:

Red Pine Mining has asked for a license for a constructed transmission line partly on public lands and partly within the Madison National Forest, in Madison County, Mont., for power and light for mining purposes.

W. W. Chadwick asked for a preliminary permit for a power development on the Rio Grande River, in Conejos and Costilla counties, Colo., and Taos and Rio Ariba counties, N. M. Mr. Chadwick proposes to construct a storage dam in the river below the mouth of Costilla Creek, and five diversion dams at intervals downstream. At each of the dams a power house is to be built, together with appurtenant works. The power will be used for mining and milling purposes in the vicinity and sold wholesale to existing distributing systems.

Arizona Power desires a license covering its project in Yavapai and Gila counties, Ariz., partly within the Coconino, Prescott, and Tonto National forests, and involving other public lands. The project consists of transmission lines totaling 100 miles; two hydro plants on Fossil Creek, a tributary of Verde River; five substations on public lands; and 11 miles of water conduit within national forests. The power capacity of the combined plants is 5,525 hp. This power is for mine utilization in Yavapai County.

Eastern Oregon Development wants a license to construct a transmission line operating at 66,000 volts, and extending for 20 miles from Baker, Ore., to a point 3 miles northeast of Keating, Ore., the power to be used for mining purposes.

Arizona Mining Congress to Meet in Morenci District

Members of the Arizona chapter of the American Mining Congress will assemble in Morenci, Ariz., on April 1 for a two-day session, according to a recent announcement. The Phelps Dodge Corporation will be the host during the two-day convention and will furnish the program and entertainment. Special scenic trips into historic spots in the Clifton-Morenci district are being planned as part of the entertainment for the visiting mining men and their ladies.

Butte Southern Makes Surface Strike

Construction work on a powder magazine, several hundred feet east of the Virgo shaft of Butte Southern Mines, in the southwest section of the Butte (Montana) district, has disclosed a new ledge on the surface. The ore in this ledge is about 2 ft. wide and assays 11.6 per cent copper and 9.6 oz. of silver a ton, according to Colonel A. P. Peake, president and general manager of the company.

Reopen Porphyry Dyke Mine, Near Rimini, Mont.

GLENN ANDERSON, Butte mining engineer, formerly with Butte Copper & Zinc and Otisco Mining, has completed a deal for the famous Porphyry Dyke mine, near Rimini, Mont. Financing is being done by a New York syndicate, headed by R. M. Atwater, of Ladenburg, Thalmann & Company.

The Porphyry Dyke was developed by the late James Breen, superintendent of the Heinze smelters. It has been equipped with a 500-ton mill, which was remodeled in 1923. Estimates of ore developed at that time were 6,250,000 tons of ore carrying $1.65 in gold a ton. The plant is connected with the main feeder line of the Montana Power Company.

Poryhyry Dyke holdings consist of nineteen patented claims, 330 acres in extent. The formation is a very unusual one, being a rhyolite lava flow containing numerous egg-shaped masses (spherulites) netted with quartz threads carrying very fine gold. The rock itself also carries clay and quartz films, containing gold.

Ardsley Butte Will Build 150-Ton Concentrator

ARDSLEY BUTTE MINES is planning construction of a 150-ton concentrator to handle ore from its Ardsley mine, in the southwest part of the Butte district of Montana. Ore will be handled mainly on concentrating tables and a "rougher" concentrate made, which will be shipped to local smelters. In opening up the Ardsley property a considerable tonnage of ore assaying from 12 to 14 oz. of silver to the ton, with some zinc and lead, has been developed, and this material will be handled in the new concentrator.

Because of the heavy flow of water, drifting on the south vein on the No. 5 level at the Highland property of the company is going forward slowly. In this vein appreciable amounts of copper have been encountered. Most of the ore extracted to date has been predominantly silver, with some lead. Shipments of high-grade silver ore, containing from 25 to 50 oz. of silver a ton, are now being made at the rate of 50 to 75 tons daily.

Tenabo Consolidated Installs New Compressor

An Ingersoll-Rand compressor is to be installed at the Gem property of Tenabo Consolidated Mines at Tenabo, 24 miles southwest of Beowawe, Nev. Shipments of copper ore are to be made from the Gem, which is developed by an incline winze, sunk to the 400 level. The company is also driving a drift from the Gold Quartz shaft of the Tenabo property on the 300 level to connect with the Gem and to prospect the Gold Quartz quartzite-limestone contact vein with which mine realization of the properties is associated.

MARKET AND FINANCIAL NEWS

March, 1929, Dividends Establish Another High Record

By Homar L. Johnson
Assistant Editor

THE upward tendency of dividend disbursements by American mining companies that has been so noticeable in the past year was decidedly in evidence this month. Further increases in payments by copper companies continue to furnish the bulk of the glad tidings to shareholders. Comparing this year's list with that recorded a year ago, American Metal's contribution to the total is somewhat greater because of an increase in the number of shares outstanding: Hecla Mining's payment is less by $100,000; Inland Steel has increased its quarterly rate from $0.625 to $0.875 per share; Calumet & Hecla, Mohawk, Nevada Con., Tennessee Copper & Chemical, and Utah Copper all report increased payments over those recorded a year ago; Hollinger's payment is less by 50 per cent; and International Nickel's new quarterly payment totals considerably in excess of the old quarterly payments of International Nickel, of New Jersey.

The only addition to the March list this year is St. Mary's Mineral Land, a holding company largely interested in some of the smaller Michigan copper producers. This company's annual payment is distributed in March this year, whereas in 1928 it was paid in April. The absentees this year are California Rand, Chile Copper, Keeley Silver, Lucky Tiger-Combination, and Mond Nickel, Mond of course being represented in the International Nickel of Canada payment. California Rand appears to have fallen by the wayside because of the sustained low silver price and unfavorable mine developments. Chile Copper's absence is occasioned by a rearrangement of schedule resulting from Chile-Anaconda stock interchange, a condition that undoubtedly will be adjusted by the payment of two dividends in one of the remaining quarters of the year. Keeley has paid no dividends since the one reported just a year ago, and Lucky Tiger-Combination has reported no payments this year, though its disbursements in 1928 were larger than in some time.

A comparison of dividend payments during corresponding quarter months of the past two years is shown in the accompanying tabulation.

	March	June	September	December
1927	$27,517,715	$34,142,501	$32,308,142	$34,512,054
1928	32,299,402	33,828,275	34,481,226	44,769,065
1929	38,852,438	.....	.....	.....

With a continuation of the exceptionally favorable copper-market situation and the improvement in lead to be considered also, a continuation of the upward tendency of dividend totals seems assured.

E. & M. J. Compilation of Mining Dividends and Yields for March, 1929

Companies in the United States	Situation	Per Share	Total	Per Cent Annual Yield
American Metal	U. S. and Mex.	$0.75 Q	$484,947	4.4
American Metal, pfd	U. S. and Mex.	1.50 Q	150,000	5.1
American Smelting & Refining, pfd	U. S. and Mex.	1.75 Q	875,000	5.2
Bunker Hill & Sullivan, s, l	Idaho	0.75 M	245,250	6.3
Butte & Superior, z, s	Mont.	0.50 Q	145,099	19.5
Calumet & Arizona Mining, c	Ariz.	1.50 Q	964,135	4.5
Calumet & Hecla Consolidated, c	Mich.	1.00 Q	2,005,502	7.1
Federal Mining & Smelting, pfd., s, l, z	Idaho, Okla.	1.75 Q	126,000	6.5
Golden Cycle Mining & Red., g	Colo.	0.04 Q	60,000	9.2
Hecla Mining, l, s	Idaho	0.15 Q	150,000	2.9
Homestake Mining, g	S. D.	0.50 M	125,580	9.6j
Inland Steel	Minn.	1.875 Q	1,034,950	3.8
Isle Royale, c	Mich.	0.50 SA	75,000	5.3j
Mohawk Mining, c	Mich.	1.50 Q	172,500	13.3j
National Lead	U. S.	1.25 Q	387,289	3.3
National Lead, pfd. "A"	U. S.	1.75 Q	426,433	5.0
Nevada Consolidated Copper	Nev., Ariz., N. M.	0.75 Q	3,641,332	5.2
Republic Iron & Steel	U. S.	1.00 Q	300,000	4.3
St. Joseph Lead, l, z	Mo., N. Y.	0.75 QX	1,462,821	3.8
St. Mary's Mineral Land, h	Mich.	2.00 A	320,000	7.4j
Sloss-Sheffield Steel & Iron	Ala.	1.50 Q	150,000	5.0
Tennessee Copper & Chemical	Tenn.	0.25 Q	198,656	5.4
Texas Gulf Sulphur	Texas	1.00 Q	2,540,000	5.5
Tintic Standard, s, l, c	Utah	0.30 Q	345,874	8.9
U. S. Steel	U. S.	1.75 Q	12,453,411	3.8
Utah Copper	Utah	4.00 Q	6,497,959	4.8
Companies in Other Countries				
Hollinger Consolidated Gold	Ont.	0.05 FW	246,000	7.8
International Nickel of Canada (new) n, c	Ont.	0.20 Q	2,869,200	1.3
Lake Shore, g	Ont.	0.20 Q	200,000	4.1j
McIntyre-Porcupine, g	Ont.	0.25 Q	199,500	4.5
Total			$38,852,438	

s, silver; l, lead; z, zinc; c, copper; g, gold; n, nickel; h, holding; Q, quarterly; QX, 50c. regular quarterly and 25c. extra; M, monthly; EW, every four weeks; SA, semi-annually; A, annually; j, based on dividends for the last twelve months.

Stock-selling Permits Granted Three Mining Companies

Stock-selling permits have been issued recently to the Eastman Consolidated Mine Corporation, of San Jose, Calif., which is interested in mining property near French Gulch, Trinity County; to the Gold Knoll Mining Company, of San Francisco, which is interested in property near Hodson, Calaveras County; and to the Mateo Mining Company, which is opening the old Campo Seco property, in Calaveras County.

New Canadian Holding Company Is Formed

Active development of the various properties controlled by the Anglo-London Mining Corporation is expected during the coming season. The company, which is organized under the laws of the State of Delaware, with extra provincial rights in Ontario, has an authorized capitalization of 500,000 common shares of $5 par value and 20,000 6½ per cent cumulative preferred shares of $25 par value. It has a controlling interest in the Alexandria Mining Company, Ltd. It has a 90 per cent interest in the Taylor mine, in the Sudbury district, and a controlling interest in the Babine Bonanza Mining & Milling Company, of British Columbia. Thomas E. Davey is general manager of the Alexandria mine and of the Babine Bonanza.

Dominion Explorers, Ltd., one of the group of Lindsley companies, has called a shareholders' meeting for March 19, to ratify a proposal to increase the capital from 2,000,000 shares to 5,000,000 shares of no-par value. The increase in capital is for the purpose of raising more money to carry on exploration and prospecting. The company is carrying on an extensive campaign in northern Ontario, and in Manitoba right up to the Arctic Circle. During the past few weeks tractors made a journey of 500 miles from the rail to Chesterfield Inlet, bringing in supplies for summer operations.

London Financial News

By W. A. Doman
Special London Correspondent

London, March 5, 1929—After the excitement of the last few weeks in connection with the Rhodesian copper companies, and the participation in financing by American houses, business in the mining market has slowed down. To some extent this is attributable to the fact that Easter is approaching and that many people in the city have money to spend. There is, however, another factor—that of money itself. Whether warranted or not, a kind of fear exists that the speculation in Wall Street is going too far and that another advance in the price of money may be the result. The explanation of the fear is that if the Federal Reserve Bank should charge more for advances, the Bank of England would be compelled to follow the lead in order to prevent a further efflux of gold from this country, seeing that so much has already gone to different centers. The fear exists not only in the mining market; it pervades the whole of the London Stock Exchange at the moment. A contributory factor is also the flood of new issues here with shares of small denomination, thus tapping the resources of people who previously have not speculated or invested on the London Stock Exchange. There are consequently fewer buyers of the older securities.

Copper rose at the end of last week to £83 13s. 9d. a ton, and Rio Tinto shares reached 64½. Yesterday, however, quotations for the metal declined to £82 7s. 6d., and Paris came in a seller, which unsettled positions here. This can be but temporary, for in view of the great electrical schemes that are in prospect, the consumption of the metal will increase, and the price will continue firm. One of the strong spots at the moment is Rhodesia Katanga Junction Railway. This title now is a misnomer, as the company has disposed of its railway undertaking to the British South Africa Company, and retains only the Kansanshi mine. Owing to the high-grade ore of the Kansanshi, it is said that an American firm is desirous of assisting in the development of the property, and of course of securing a share interest. As apparently there are only about 118,000 shares free—the others being held by big corporations like the Tanganyika Concessions and the Zambesia Exploring Company—the price of these shares is increasing.

For some time tin has been steady in the neighborhood of £226 per ton. At this level it was thought to be stabilized, or at any rate this was thought to be the minimum. The belief, however, has proved incorrect, for yesterday the price fell to £220 7s. 6d. Naturally, the drop does not disturb the big corporations which are cognizant of the nature of the supplies; it is upsetting only to those small holders who fancy they see reduced dividends.

Russo-Asiatic Consolidated has not yet definitely settled its negotiations with the Soviet representatives. Apparently there are still one or two knotty problems for solution. The Soviet, however, seems to be more amenable to reason, if the arrangement made concerning the disposal of Russian oil can be accepted as a criterion.

A rumor is in circulation that the house of Rothschild is buying Rhodesian Congo Border shares on behalf of the Rio Tinto Company.

National Metal Exchange to Deal in Copper

TRADING in copper futures will be initiated on the National Metal Exchange in the near future, according to a recent announcement. I. J. Louis, chairman of the copper committee which has been investigating the practicability of trading in that metal, recommended that copper be listed on the exchange. The recommendation received the unanimous approval of the board, which instructed the copper committee to draw up the necessary rules for trading in this metal.

Considerable agitation on the part of trade and commission-house brokers for listing of this metal on the National Metal Exchange has arisen because the spectacular bull market has featured copper trading during recent months. The initiation of futures copper trading on the exchange will, it is believed, witness a considerable broadening of activity in future positions and tend to stabilize the copper market.

Listing of lead and antimony on the National Metal Exchange is also under consideration, committees being engaged in surveying the market position of those metals upon instructions from the board of governors of the exchange.

Evans-Wallower Capital Structure Changed

Stockholders of Evans-Wallower Lead Company have approved a change in the charter of the organization providing for an increase in the number of authorized no-par common shares from 500,000 to 625,000. This increase will enable the company to make a stock exchange with Eastern Electrolytic Zinc Company, by which it will become sole owner of the Tainton electrolytic zinc process in the United States, with the exception of the Kellogg (Idaho) plant of the Sullivan Mining Company.

Engels Copper Company reports a net deficit of $54,345 for 1928. Total income for 1928 from metal sales was $1,717,651; operating expenses exclusive of development, depreciation, and depletion amounted to $827,652. Bonded indebtedness was decreased $29,500. Consummation of the sale of the Indian Valley railroad is expected to place the company in a much better financial position. Current assets total $437,731 and current liabilities, $102,318.

Dome Mines, of Porcupine, during the month of February treated 42,800 tons of ore and recovered $316,142, an average recovery of $7.38.

Shattuck Denn has Greater Loss in 1928 Than in 1927

SHATTUCK DENN Mining Corporation for year ended Dec. 31, 1928, reports loss of $95,879 after expenses and taxes, comparing with loss of $8,800 in 1927. After charging out depreciation and depletion, the net loss was $221,325 in 1928, against net loss of $116,954 in previous year.

Income account for year 1928 compares with that of 1927 and 1926 as follows:

	1928	1927	1926
Gross income	$713,605	$909,003	$1,153,499
Market and development changes	747,710	880,272	1,070,046
Taxes	61,774	37,531	(b) 32,108
Loss	$95,879	$8,800	(a) $51,845
Depreciation and depletion	125,446	108,154	87,164
Net loss	$221,325	$116,954	$35,819

(a) Profit. (b) Includes interest.

President L. C. Shattuck states that the year 1928 witnessed very satisfactory progress at the Denn mine. To extract the ore in the lower levels to the best advantage, the shaft was sunk to the 2,200 level and a new electrical hoist was installed. This installation was completed toward the end of the year, and production in 1929 is expected to show a steady increase.

The Shattuck mine was operated throughout 1928, producing about two-thirds the tonnage obtained in 1927. Low-grade lead ore was shipped to the Phelps Dodge concentrator until June 1, when the low price of lead caused suspension of this production. The copper ore tonnage for the year came from developing small orebodies adjacent to the old stope areas and exceeded the previous year's production by over 10,000 tons.

Although the results for the year show a loss, it seems advisable to continue this production while prospecting the undeveloped areas of the property.

During the year the Denn shaft was deepened from 2,028 ft. to 2,248 ft. and stations were cut on the 2,100 and 2,200 levels. Exploration and development work was continued on the 2,000 level, proving the new orebody on this level to be approximately 50 ft. wide and 200 ft. long, averaging around 7 per cent copper, with a combined gold and silver content valued at $1.50 a ton. The limits of this ore above the 2,000 level have not yet been determined, but the tonnage is greater than original estimates. The orebody has been partly outlined to the 2,200 level by diamond drilling, and drifts are now being driven on the 2,100 and 2,200 levels to complete this development and prepare for extraction.

Moore Mining Company, operating near Jackson, Calif., milled 13,158 tons of ore in 1928, receiving $90,647 gross returns, including tailing royalties. Operating expenses were $68,476 and operating profit was $22,170. Receipts from tailing royalties were $1,566. Preliminary work directed toward exploring deeper veins is under way.

National Lead 1928 Earnings Higher Than in 1927

NATIONAL LEAD Company reports net profit of $5,872,496 in 1928. After preferred dividends, taxes, and reserves this is equivalent to $11.44 per share on 309,831 shares of common stock outstanding, which compares with net profit of $4,929,396, or $8.90 per share, in 1927. Financial statement for 1928 is compared with that of 1927 and 1926 in the accompanying tabulation.

Edward J. Cornish, president of the company, states that with the exception of white lead-in-oil, the sales of which have declined compared with the record for previous years, the business of the company has been very satisfactory. Sales of babbitt, solder, type metals, sheet lead, lead pipe, and all of the specialties show a satisfactory increase.

In the report for 1924, stockholders were advised that the dividends received from tin-mining companies were being charged against the original cost thereof in lieu of a depletion charge, to the end that when such mines are ultimately exhausted there will be no capital loss. Stockholders are now advised that, having reduced the cost of said properties on the company's books to a sum that needs no further depletion or depreciation, all of the dividends in said companies are being included in the net earnings and reflected in the foregoing statement as earnings.

Following the retirement of John R. Wettstein, president of United Lead Company, its plants and sales organization were consolidated with those of the National Lead Company.

The company has concluded to carry its own group life insurance for its employees. Each employee who has been in the employ of the company more than one year is insured by the company in an amount equal to one year's salary or wage, with a limitation that no one shall be insured for more than $5,000. It is quite proper, the report states, that an insurance reserve should be created for the purpose of meeting this liability; but inasmuch as the tax reserve is perhaps excessive, it has been concluded that the creation of such a new reserve will be delayed for the present.

The titanium pigment plant at Leverkusen, near Cologne, Germany, which is being built by the Titangesellschaft M. B. H., is completed and in operation. Company specialists who have been assisting in the preparation of plans for this plant commend most highly the efficiency of their associates in this enterprise, the I. G. Farbenindustrie Aktiengesellschaft, of Germany, which has directed the construction of the plant. They report that the plant has been constructed very substantially, and that it includes many technical improvements resulting from the intimate knowledge of such work. Stockholders should again be advised that this titanium pigment is new. The public must be educated to its use and virtues. Distributing agencies must be established. Promotion work is necessary.

	1928	1927	1926
Net profit (a)	$5,872,496	$4,929,396	$9,004,567
Class A preferred dividends	1,705,732	1,705,732	1,705,732
Class B preferred dividends	(b) 619,661	†464,747	.....
Old common dividends	.....	413,108	1,652,432
New common dividends	1,549,155	1,161,866	.....
Surplus	$1,997,948	$1,183,943	$5,646,403
Profit-and-loss surplus	15,243,237	13,245,289	32,716,746

(a) After deducting expenses, taxes and reserves.
(b) Includes $154,915 payable Feb. 1, 1929.

Bunker Hill & Sullivan Earnings Declined Slightly in 1928

NET EARNINGS of the Bunker Hill & Sullivan Mining & Concentrating Company, after depletion, totaled $2,255,749 in 1928, as against $2,658,987 in 1927. Financial statements for 1928 and 1927 are compared in the accompanying table:

	1928	1927
Production revenue	$6,932,271	$6,724,248
Production and marketing costs	4,365,082	4,248,864
Operating profit before depletion	$2,475,383	$2,567,189
Other revenue, after income taxes	451,965	789,961
Operating surplus before depletion	$2,927,349	$3,357,150
Depletion	671,600	698,164
Operating surplus after depletion	$2,255,749	$2,658,987
Dividends paid	3,003,962	2,993,628
Deficit to profit-and-loss surplus	748,213	334,641

Stanly A. Easton, the manager of the company, reports that the mines and reduction plants of the company were operated satisfactorily throughout the entire year, with production very close to the record output of 1927.

An event of outstanding importance was the completion and successful starting of the electrolytic zinc reduction plant of the Sullivan Mining Company, owned one-half by Bunker Hill and one-half by Hecla Mining Company. Shipments from its output of "Bunker Hill" brand slab zinc began early in November. This zinc is of unequaled purity and of a quality not heretofore available to the trade; it is being extremely well received. At this date production is at the rate of 1,500 tons per month and it will be increased to 1,800 tons in due course. The zinc reduction plant has received its ore supply from a stockpile of zinc concentrates accumulated while the plant was under construction, supplemented by current production of the Sidney and Bunker Hill mines. Production from the Star mine of the Sullivan Mining Company is now being resumed, and the output from this property will eventually be the plant's chief source of supply.

Recovery of zinc from Bunker Hill ore was begun in the early part of the year. From this work 6,008,794 lb. was realized, and, with improved facilities, the rate of yield is being substantially increased. This zinc production from the Bunker Hill mine is due solely to better and more modern metallurgy and not to an increased amount of zinc in the ore. Production costs were slightly lower, and the average price received for lead was a little below that of 1927. The mine operating profit was very nearly equal to that of 1927.

No shaft sinking was done during the year, but extensive lateral exploration work was accomplished on several levels. Further development was done on the ore exposed on the No. 19 level east, noted in the last report. On the same bottom level of the mine, 2,000 ft. vertically below the Kellogg Adit Tunnel, an important orebody was exposed by the westerly workings. The extent of this new ore is not yet shown, as development continues. It is not believed to be the Towers-March-July oreshoot which has been so extensively mined clear to the surface in the levels above.

Metal production for the last two years compares as follows (mine output):

	1928	1927
Silver, oz.	1,769,528	1,799,841
Lead, lb.	91,241,389	94,971,072
Zinc, lb.	6,008,794	.....

Ore reserves at end of 1928 compare with those at end of 1927 as follows:

	Short tons	
	1928	1927
Sullivan mine	232,953	183,879
Bunker Hill mine	2,529,247	2,824,763
	2,762,200	3,008,642

During 1928 a total of 452,345 tons of ore was mined and milled. Total operating costs amounted to $4.53 per ton.

Santa Gertrudis Earnings Show Large Decline in 1928

Net income of the Santa Gertrudis Company, Ltd., before deducting for depreciation or depletion, was $397,367 in 1928, as against $520,093 in 1927. A total of 163,251 dry tons of ore was mined at the different properties of the company in 1928, which compares with 181,880 tons in 1927. The average price received from sales of silver during 1928 was $0.5822 per ounce 999 fine.

On Dec. 15, 1928, production ceased at the El Cristo mine of the Inversiones Company, one of the Santa Gertrudis subsidiaries. The average flow of water from the Dos Carlos workings during 1928 was 4,970 g.p.m.

SIERRA MARBLE COMPANY has been granted permission by the California State Corporation Department to issue Class B preferred stock to holders of first mortgage bonds of the Bell-Columbia Marble Company, which operated quarries in Tuolumne County, Calif., and company stock, both preferred and common, to stockholders of the Sierra Marble Company, Inc. The new company is the outgrowth of the former Bell-Columbia Company.

IDAWA GOLD MINING COMPANY, operating the Belshazzar mine, near Boise, Idaho, paid an initial dividend of 7c. per share, totaling $56,000, in December.

A. S. & R. 1928 Earnings Establish New High Record For Peace-Time Operation

THE 1928 annual report of the American Smelting & Refining Company indicates earnings at a record rate. Net income for the year, after allowing for depreciation, depletion, interest, federal taxes, and preferred-stock dividends, totaled $18,586,203, compared with $15,477,769 in 1927 and $17,760,721 in 1926. Simon Guggenheim, president of the company, states that during the year, without any additional financing, the company expended the following amounts: For retirement of 6 per cent "B" bonds, $9,943,750; for improvements and betterments on existing plants and for entirely new undertakings, including acquisition of interest in Republic Brass Corporation, $14,971,900, a total of $24,915,650.

As a result of the special stockholders' meeting of Dec. 18, 1928, changing the capital structure of the company, there is now in the treasury, subject to issue at the discretion of the directors, the entire issue of authorized 6 per cent second-preferred stock ($20,000,000 par value) and 2,170,060 shares of common.

Continuing its policy of extending its operations into the manufacturing field, especially of copper, the company acquired during the year over 90 per cent of the stock of Michigan Copper & Brass Company, which, in December, together with the Rome Brass & Copper Company, Taunton-New Bedford Copper Company, Dallas Brass & Copper Company, and Higgins Brass & Manufacturing Company, sold all assets to a new company known as "Republic Brass Corporation," in which A. S. & R. has a substantial interest.

The new lead refinery in Monterey, Mexico, is expected to start operation in March, 1929, and gives promise of substantial profits. Zinc smelters have been greatly improved and should yield increased earnings from now on. The Buchans River mine, in Newfoundland, is operating satisfactorily, and earnings therefrom will appear in 1929. Further expansion is under consideration.

In recognition of the loyal and effective services of the organization, a special distribution of 8 per cent of the year's salary was made to all salaried employees in the service of the company throughout 1928.

Comparison of Metal Production

	1928	1927	1926
Gold, oz.	1,407,286	1,479,899	1,634,158
Silver, oz.	81,434,214	80,671,759	85,482,438
Copper, tons	563,713	536,830	525,897
Lead, tons	471,880	476,988	469,607
Zinc, tons	47,433	52,170	48,723

Income for 1928 is compared with that for 1927 in the accompanying table.

Financial Statement

	1928	1927
Total net earnings	$29,037,465	$26,133,601
Other income	2,064,297	1,837,004
Total income	$31,101,763	$27,970,606
General expenses, taxes	4,316,287	4,026,606
Interest and depreciation	8,199,272	8,466,230
Net income	$18,586,203	$15,477,769
Dividends	8,989,820	8,379,840
Surplus income	$9,596,383	$7,097,929

Total current and miscellaneous assets stand at $92,994,348, almost four times current and miscellaneous liabilities of $23,631,265. During 1928 total assets decreased $3,098,929 and total liabilities increased $4,084,780. The investment asset account increased $8,937,496.

Alaska Juneau Expands Scope of Operations

IN the annual report of Alaska Juneau Gold Mining Company, F. W. Bradley, president of the company, reports operating profits for the year 1928, before interest and depreciation, as $1,156,799. He states that the assurance of continuous and substantial profits justifies the policy of expanding operations over the mining field tributary to Juneau, Alaska. Working development options have taken on two prospects, one the Taku River group, consisting of nine mining claims covering the outcrop of a lead-zinc-gold-silver formation, and the other, the Stampede group consisting of nine British Columbia mining claims, covering the outcrop of a gold quartz vein for a length of 6,500 ft. Samples taken along 2,400 ft. of this outcrop show an average gold content of $7.83 per ton for an average width of 2.3 ft. Mr. Bradley states that the chances in this property are good for finding oreshoots with widths and values greater than those so far found along the outcrop. The Taku River venture belongs exclusively to Alaska Juneau, but the Stampede venture is shared 50-50 with Treadwell Yukon, which is operating in Canada.

Present plans contemplate, in the event of successful prospecting, the use of 54,000 shares of unissued Alaska Juneau stock for financing permanent equipment on these properties.

Mr. Bradley states that, as authorized at the annual meeting of April 9, 1928, 29,000 shares of Alaska Juneau stock were issued on Nov. 23, 1928 to Alaska Treadwell Gold Mining Company, 8,500 shares to Alaska Mexican Gold Mining Company, and 8,500 shares to Alaska United Gold Mining Company, for all of the physical properties of these companies situated in Alaska. The property includes a foundry, machine shop and three hydro-electric power plants. As of Feb. 21, 1929, Alaska Juneau had bonds outstanding to the amount of $1,483,100. The additional indebtedness of unpresented bond coupons and open accounts payable is exceeded by cash now on hand and by other liquid assets.

Production for 1928, totaled $3,316,019; operating and marketing costs, $2,159,219; and gross operating profit including rentals was $1,156,997. Interest charges totaling $176,898 and plant depreciation of $198,993 reduced the net profit before depletion to $781,106. The deficit in surplus account as of Dec. 31, 1928, was $588,919. Total tons handled for the year were 3,718,140 of average gold assay value $1.11 per ton.

Arizona Commercial Earned $173,611 Before Depletion

ARIZONA COMMERCIAL Mining Company, copper producer of the Gloze (Arizona) district, reports earnings before depletion amounting to $173,611 from operations in 1928, as shown in the accompanying tabulation:

Profit-and-Loss Account

Income from metal sales	$862,729	
Interest	17,733	
Total income		$880,463
Expenses:		
Mining, treating, and refining	$616,064	
Selling, general and administrative (including payment of back taxes)	43,356	
Depreciation	47,430	
Total expenses		706,851
Income before depletion, for the year 1928—carried to balance sheet		$173,611
Depletion	180,797	
Dividends	132,500	
		313,297
Deficit to surplus account		$139,686

Metal production amounted to 4,665,605 lb. copper, 29,074 oz. silver, and 793 oz. gold. The company's production was milled at the Old Dominion concentrator. A total of 60,948 tons of ore, assaying 4.48 per cent copper, was concentrated during 1928, which compares with 65,985 tons assaying 4.70 per cent copper milled in 1927. Development work during 1928 totaled 3,114 ft., as against 3,531 ft. in 1927.

Sumner Smith, president of the company, states that development work done during recent years has not added to the ore reserves to any extent, and as a result the known reserves are much diminished. The directors last fall employed a well-known consulting mining engineer and geologist to examine the mine and consult with the superintendent as to future development work. The engineer advised that the ground in the upper levels was thoroughly explored and that possibilities of finding more ore there were not promising. He advised, however, that exploration by diamond drilling of the ground below the 2,200 level had a fair chance of finding ore, and this diamond-drilling work will be prosecuted vigorously during the current year.

The shafts are in good condition, and production came from No. 1 and No. 2 shafts in about equal amounts. There has been no material change in the water condition of the mine—185,000,000 gal. was pumped to the surface in 1928 as compared with 163,000,000 gal. in the previous year.

The Market Report

Copper Jumps to 23c.; Other Metals Strong

New York, March 20, 1929—A sensational advance in copper, lead, and zinc featured the metal markets in the week ending today. Copper advanced 3c., to 23c. a pound late today; and as high as 8c., New York, was paid for lead, and 6.60c. for zinc, compared with 7¼ and 6.353c. respectively a week ago. Zinc sales were particularly heavy. Tin and silver are only very slightly higher. The startling prices registered in London Monday morning, and the anxiety of foreign copper buyers, seem to have been largely responsible for the advance in quotations here.

Daily Prices of Metals

March	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
14	19.85	48.75	7.275	7.15	6.35
15	20.275	48.875	7.275	7.15@7.20	6.35
16	20.775	48.75	7.275	7.175	6.35
18	21.60	49.625	7.275	7.15@7.175	6.35
19	21.775	49.50	7.50@7.525	7.35@7.425	6.35
20	22.45	49.00	7.75@8.00	7.60@7.85	6.35@6.60
	21.121	49.083	7.415	7.296	6.371

Average prices for calendar week ending March 16, 1929, are: Copper, 19.954; Straits tin, 48.688; N. Y. lead, 7.265; St. Louis lead, 7.158; zinc, 6.350; and silver, 56.313.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

March	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
14	86½	87⅞	93½	220	219½	23 11/16	23 15/16	26⅝	26 13/16
15	90¼	91⅜	95½	221¾	221	24 1/16	24 5/16	26⅞	27⅛
18	97½	98⅞	98½	223	223	29¾	30	29	29 3/16
19	94	95⅜	102½	224⅞	225½	27½	27¾	27⅞	28
20	96¼	97½	102½	222¾	223¾	27 13/16	28 1/16	28 5/16	28⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

March	Sterling Exchange "Checks"	Silver		Gold London	March	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
14	4.84 7/16	56⅜	26	84s11½d	18	4.84⅞	56½	26	84s11½d
15	4.84¼	56⅜	26	84s11½d	19	4.85	56½	25⅞	84s10½d
16	4.84¼	56⅛	25⅞	.....	20	4.84 13/16	56½	25 15/16	84s10½d

Average, 56.313

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium

Copper Up Another Cent Today

With an advance of a full cent in the price of copper on Monday, and a similar advance today, the price reached 23c. a pound for Connecticut deliveries this afternoon, or 3c. above the level a week ago. Demand continues insistent, both here and abroad, and as producers have only a limited amount to offer, which consumers are willing to take at any price quoted, it is only human nature to raise the quotations. To what extent this can be carried is problematical. The volume of sales has been about that of an average week, in the neighborhood of 14,000 tons, with most of the business for July shipment. Many orders, however, were booked for earlier months, and it seems likely that as it becomes available, a fair tonnage will yet be released for April, May, and June, so that regular customers will be taken care of to a reasonable extent, even though they may not yet have covered themselves for four months ahead, as many have tried to do.

The foreign demand, like the domestic, has been insistent, and more than sellers could take care of. The c.i.f. price was advanced from 20¼ to 20¾c. on March 15; to 21¼c. on the 16th; and to 22¼c. on the 19th. Foreign customers still have a fair amount of April and May copper to buy, and have only just started buying for June.

Lead Prices Advance Sharply

The lack of strength in the London lead market that has been of primary importance in preventing domestic prices from reaching higher levels was suddenly and effectively corrected on Monday, March 18, when what appears to have been a wave of speculative buying swept the official quotation for spot lead up £5 14s. On Tuesday a reaction absorbed part of this spectacular advance, but nevertheless a net appreciation of £4 2½s. for the week is indicated by the London quotations. Producers report an exceptionally strong demand during the last week, though the total of sales reported is but little above normal.

The New York contract price of the American Smelting & Refining Company was advanced from 7¼ to 7½c. per pound yesterday, following the remarkable advance in London, and again from 7½ to 7¾c. per pound today. Sales have been made at premiums over the Smelting company's contract price almost every day during the last week. The St. Louis market continues very firm, and, though the bulk of the business has been done at 10 to 15 points below the New York price, special sales have been consummated in one or two instances at as much as 25 points above the New York price. Most of the sales reported during the last week have been for April and near-by shipment, producers being reluctant to quote for May as yet except to favored customers, who have had to pay a premium for that position. The general situation appears to be very strong, and in view of the indications that shipments of bullion from Mexico

may be somewhat curtailed, further price advances in the immediate future would not be surprising.

Heavy Buying of Zinc

More zinc has been sold in the week ending today than in any week since that of Nov. 28, the stronger copper and lead markets, and the strength in zinc abroad, leading buyers to expect an advance in zinc quotations in this market. This materialized today, when a large tonnage was sold at 6.50 to 6.60c., St. Louis, after sales earlier in the day had been booked at 6.35c. The 6.35c. price has been continuous since the end of November. In the business done, the date of shipment has varied all the way from prompt to August.

Tin Reacts After Slight Advance

The price of spot Straits tin advanced sharply on Monday in sympathy with the general bull market in metals on the London Exchange. However, considerable selling pressure developed at the higher quotations, and the price reacted yesterday and today. Very little change in the general situation is apparent.

Silver Quiet and Steady

Silver prices have remained at about the same level as during the previous week, and very little interest has been shown by either buyers or sellers. Buying for China account has absorbed the small offerings, as Indian rates have been slightly under parity. The undertone is quiet and steady.

Mexican Dollars (Old Mexican pesos): March 14th and 15th, 42⅜c.; 16th, 42⅜c.; 18th and 19th, 42½c.; 20th, 42¾c.

Foreign Exchange

Closing cable quotations on Tuesday, March 19, were as follows: Francs, 3.90½c.; lire, 5.23½c.; and marks, 23.72½c. Canadian dollars, 17/32 of 1 per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, 9¾c. per lb. for all positions. Market stronger. Cookson's "C" grade, spot, 14¾c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 85@95c. Active demand.

IRIDIUM—Per oz., $260@$265 for 98 @99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $70. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $122 cash. Small lots command the usual premiums.

Prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of March 9.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: wolframite, $12@$11.85; Western scheelite, $12.75@$13.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports. Exclusive of duty. Brazilian and Indian grades, minimum 47 per cent Mn, 30@32c. Market weaker.

Chrome, Iron, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the March 9 issue.

Lead Concentrate Quotations Unchanged

Joplin, Mo., March 16, 1929

Blende	Per Ton
High	$43.25
Premium blende, basis 60 per cent zinc	$41.00@ 42.00
Prime Western, basis 60 per cent zinc	40.00@ 41.00
Fines, table concentrates, 60 per cent zinc	37.00@ 39.00
Slimes, flotation concentrates	36.00@ 38.00
Average settling price, all zinc	41.63
Galena	
High	$103.00
Basis 80 per cent lead	100.00
Average settling price, all lead	97.87

Shipments for the week: Blende, 14,580; galena, 3,560 tons. Value, all concentrates the week, $995,310.

Buyers insist that no higher basis price is being paid for lead than $100, asserting that several hundred tons could be purchased at $102.50.

The zinc shipment was 400 tons more than the production, lowering bin stocks slightly. Approximately 40 per cent of the stock in bins is sold for future delivery, the bulk of remaining stocks being held by two companies, which are easing off a portion each week. It is estimated that production has advanced to a tonnage approximately equaling weekly shipments, and no further reduction in stocks may be made. Demand has become sufficiently acute to accept for shipment stocks of ore heretofore passed over because unclassified.

Platteville, Wis., March 16, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$43.25
Lead Ore	
Lead basis 80 per cent	$100.00

Shipments for the week: Blende, 772 tons; lead, none. Shipments for the year: Blende, 7,207; lead, 320 tons. Shipments for the week to separating plants, 1,526 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the March 9 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market firm.

Antimony Oxide, Copper Sulphate, Calcium Molybdate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the March 9 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.04@$1.10.

NICKEL SILVER—Price advanced to 35⅜ from 35c. per lb. for 18 per cent Grade A sheets effective March 16.

YELLOW (MUNTZ) METAL—Price for dimension sheets advanced to 27¼ from 26½c. per lb.; and for rods to 24¼ from 23½c. per lb., both effective March 19.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium and Ferrovanadium are unchanged from prices in the March 9 issue.

Rolled Metals

COPPER—Price for sheets, hot rolled, advanced to 31¾ from 30¾c. per lb., effective March 19; and for wire to 24⅞ from 23⅞c. per lb., effective March 20.

LEAD SHEETS—Price of full-rolled sheets advanced to 11½ from 11c. per lb.; for clipped sheets advanced to 11¾ from 11¼c. per lb., effective March 20.

Monel Metal, Nickel, and Zinc Sheets are unchanged from prices in the March 9 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of March 9.

Iron, Steel and Coke

Iron—Per gross ton, Valley furnaces, Bessemer, $18.25@$18.50; basis, $17.50 @$18; No. 2 foundry, $18.

Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33@$34; plates, structural shapes, and soft steel bars, per lb., $1.90@$1.95.

Coke—Per gross ton, Connellsville furnace, $3.00. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky, $8; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ending March 16, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	164	150½	163¾	Mr.29,My.20 Q	1.75
Andes Copper	New York	66	60½	66	Mr.29, My.6 Q	0.75
Arizona Com	Boston	4½	4	4	Ja. 16, Ja. 31 S.A.	0.25
Calumet & Ariz	New York	140½	130½	140½	Mr.7, Mr.25 Q	1.50
Calumet & Hecla	Boston	57½	54½	56½	Fe. 28, Mr. 30 Q	1.00
Cerro de Pasco	New York	115¾	109	115½	Ja. 11, Fe. 1 Q	1.25
Chile Copper	New York	120	108½	120	Mr.22, Ap.22 Q	0.87½
Con. Coppermines	N. Y. Curb	17½	15½	17½		
Copper Range	Boston	31½	29½	30½	Mr.15, Ap.15 Q	0.50
East Butte	Boston	4½	4	4½	Dec., 1919	0.50
Granby Con	New York	95½	89½	95½	Ja. 4, Fe. 1 Q	1.00
Greene Cananea	New York	188½	172½	187½	Mr. 7, Ap. 1 Q	2.00
Howe Sound	New York	79½	73½	79½	De. 31, Ja. 5 Q	1.00
Hudson Bay	N. Y. Curb	21½	20½	20½		
Inspiration	New York	63½	59½	63½	Mr.14, Ap. 1 Q	1.00
Isle Royale	Boston	33½	31½	33½	Fe. 28, Mr. 30 X	0.50
Kennecott	New York	103½	94½	103½	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	79½	73½	79½	De. 31, Ja. 15 Q	1.00
Mason Valley	N. Y. Curb	1½	1½	1½		
Miami Copper	New York	53½	47½	53½	Fe.1, Fe.15 Q	0.50
Mohawk	Boston	51	48	50½	Ja. 26, Mr. 1 Q	1.50
Mother Lode	New York	5½	5	5½	De.14, De.31 SA	0.20
Nevada Con	New York	61½	56½	61½	Mr 15, Mr.30 Q	0.75
New Cornelia	N. Y. Curb	46½	44	46½	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	61	58½	59½		
Ohio Copper	N. Y. Curb	3½	3½	3½	Sept., 1926	0.03
Old Dominion	Boston	17½	16½	17	Dec., 1918	1.00
Phelps Dodge, old		345½	338½	340		
Phelps Dodge, new	N. Y. Curb	88½	84½	86½	Mr. 15, Ap. 1 Q	2.5
Quincy	Boston	46½	42½	45	March, 1920	1.00
Roan Antelope	N. Y. Curb	48¾	44½	48		
St. Mary's M. L.	Boston	42½	39½	42½	Fe.25, Mr.12	2.00
Seneca Copper	New York	8	6½	7½		
Shattuck Denn	N. Y. Curb	25½	22½	25		
Sherritt-Gordon	Toronto	9.90	9.25	9.60		
Tenn. C. & C.	New York	18½	18½	18½	Fe.28, Mr.15 Q	0.25
United Verde Ex	N. Y. Curb	19½	17½	19½	Ja. 4, Fe. 1 Q	0.75
Utah Copper	New York	350	335	350	Mr. 15, Mr. 30 Q	3.00
Waite-Ark.-Mont	Toronto	1.50	1.50	1.50		
Walker Mining	Salt Lake	3.75	3.35	3.75		
Wenden Copper	N. Y. Curb	2	1½	2		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	3½	3½	3½		
Amer. Z. L. & S.	New York	47½	43	47½	May, 1917	1.00
A. Z. L. & S., pfd.	New York	104	102	104	Nov., 1920	1.50
Bingham Mines	Boston	54	54	54	Mr.15, Ap.5	0.50
Bunker Hill & S.	N. Y. Curb	143	141½	141½	Fe.28, Mr.5 X	0.75
Butte Cop. & Zn.	New York	9½	8½	8½		
Butte Cop. Con.	Boston Curb	*94	*85	*85		
Butte & Sup.	New York	10½	9½	9½	Mr. 15, Mr. 30 Q	0.50
Callahan Zn-Ld.	New York	3½	3½	3½	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.65	3.50	3.57½	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	11½	10½	11½	Ap.5, Ap.10	0.25
Constitution	Spokane	*29	*21	*29		
Dayrock	Spokane	2.60	2.35	2.55		
Dickens Consol	Spokane	14½	11½	*13½		
Eagle-Picher	Cincinnati	19½	19	19	Mr.31, Ap.15 Q	0.20
Eagle-Pich., pfd.	Cincinnati			102	Jan. 15 Q	1.50
Erupcion	Boston Curb	*20	*18	*18	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	*79	*77	*77		
Eureka Lily	Salt Lake			1.42½		
Eureka Standard	Salt Lake	4.75	4.60	4.75		
Evans-Wallower	N. Y. Curb	22½	20½	20½		
Evans-Wal., pfd.	N. Y. Curb	90	83½	89½	Jan. 15, I	1.75
Federal M. & S.	New York			301	Je., 1927	10.00
Fed. M. & S., pfd.	New York			107½	Fe. 21, Mr. 15 Q	1.75
Gladstone	Spokane	*15	*13½	*13½		
Golconda	Spokane	1.15	1.05	1.06	Mr.20, Ap.1 Q	0.02
Grandview	Spokane	*59	*52½	*57½		
Hecla Mining	N. Y. Curb	21½	19	20½	Fe.15, Mr.15 M	0.15
Highland-Surprise	Spokane	*17½	*16½	*16½		
Jack Waite	Spokane	*15	*14	*14½		
Kootenay Florence	Spokane	*18½	*17½	*17½		
Lucky Jim	Spokane	*17	*17	*17		
Lucky Tiger-C	Kansas City	†5.75	†5.25		De.4, De.20 MX	0.12
Mexican Premier	Spokane	1.37	1.28	1.36		
National Lead	New York	158½	149	155½	Mr. 15, Mr. 31 Q	1.25
Natl. Lead, pfd. A	New York	141	140	141	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	118	118	118	Ap. 19, My 1 Q	1.50
N. J. Zinc	N. Y. Curb	310	300	308½		
N. J. Zinc, new	N. Y. Curb	81	77½	80		
New Quincy	Salt Lake	2.40	1.85	2.30		
Noble Five	Spokane	*68	*65	*65		
North Lily	Salt Lake	9.50	9.10	9.50	Jan. 20 Q	0.25
Park Bingham	Salt Lake	*10½	*9½	*10		
Park Utah	New York	12½	12	12½	Mr. 19, Ap.1	0 Q 0.20
Pend Oreille	Spokane	11.00	10.00	11.00		
Rico Argentine	Salt Lake	4.60	4.30	4.50	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*47	*45	*46		
St. Joseph Lead	New York	80½	75½	78½	Ju. 8, Ju.20 QX	0.75
Sherman Lead	Spokane	*35	*29½	*35		
Silver King Coa.	Salt Lake	14½	14½	14½	De. 15, Ja. 2 Q,	0.25
Silversmith	Spokane	*13½	*12	*12	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	1.59	1.53	1.56	De. 20, BM	0.02
Tamarack-Custer	Spokane	*56	*48½	*56	Sept., 1924	0.25
Tintic Standard	Salt Lake	15	14½	15	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb			1½	Oct., 1925	0.05
Treadwell-Yukon	Toronto	16.50	14.00	15.00		
United Zinc Smg	N. Y. Curb	1½	1½	1½		
Utah Apex	Boston	6	5½	6	Je. 14, Au. 1 K	0.25
Utah Met. & Tun.	Boston	2	1½	1½	Dec., 1917	0.30
Whitewater	Spokane	1.05	1.00	1.00		
Yellow Pine	Los Angeles	*15	*10	*15	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	8½	7½	7½		
Barry-Hollinger	Toronto	*31	*28	*28		
Central Manitoba	Toronto	*60	*53	*53		
Coniaurum	Toronto	1.15	*25	*25		
Cresson Consol.	N. Y. Curb	*95	*91	*92	Jan. 15, Q	0.02
Dome Mines	New York	10½	9½	9½	De. 21, Ja. 21 Q	0.25
Golden Cycle	Col. Springs	†1.69	†1.64		Fe.15, Mr.1	0.04
Gold Hill	Toronto	*6½	*5	*5½		
Hollinger	Toronto	8.35	8.00	8.00	Mr.8, Mr.25 FW	0.05
Homestake	New York	73½	72½	73	Mr.20, Mr.25 M	0.50
Kirland Lake	Toronto.	1.45	1.33	1.36		
Lake Shore	Toronto	25	24½	24½	Mr.1, Mr.15 Q	0.20
McIntyre-Porc.	New York	22	20½	20½	Fe.1, Mr.1 Q	0.25
Portland	Colo. Springs	†*16	†*9½		April, 1927	0.02
Rand Mines	New York			36½	Fe. 21,'28 Am.Sh.	1.52
Siscoe	Toronto	1.00	*85	*92		
Sylvanite	Toronto	2.10	2.00	2.00		
Teck-Hughes	Toronto	9.75	9.25	9.50	Ja. 31, Fe. 1 Q	0.15
Tom Reed	Los Angeles	*35	*15	*15	Dec., 1926	0.02
Unity Gold	N. Y. Curb	1	*90	*95		
Vipond Consol	Toronto	1.17	1.10	1.17	April, 1927	0.03
Wright-Hargreaves	Toronto	2.20	2.05	2.12	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb			35½		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	18½	18	18		
Castle-Trethewey	Toronto	*39	*38	*38		
Consol. Cortez	N. Y. Curb	*18	*16	*16		
Dolores Esperanza	N. Y. Curb	1½	1½	1½	July, 1923	0.05
Keeley	Toronto	*46½	*46	*46½	Mr.15, 1928	0.04
Mining Corp.	Toronto	5.50	5.20	5.35	De.14,De.31 SA	0.15
Montana-Idaho	Spokane	*11	*9	*9½		
N. Y. & Hond. Ros.	N. Y. Curb	16½	16	16	Ja.16, Ja.26 QX	0.50
Nipissing	N. Y. Curb	3½	3½	3½	Mr.30,Ap.20 Q	0.07½
Premier Gold	N. Y. Curb	1½	1½	1½	Mr.14, Ap.1	0.06
Tonopah Exten	N. Y. Curb			*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3 11/16	3½	3½	Se. 29, Oc. 20 SA	0.07½
United Eastern	N. Y. Curb	1	*91	*91		
Yukon Gold	N. Y. Curb	*80	*80	*80	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	111½	98	108½	Fe. 15, R	1.00
Beth. Steel, pfd, 7%	New York	120	119½	120	Mr.4, Ap.1 Q	1.75
Cleveland-Cliffs	Cleveland	200	135	170	Ja.15, Ja.25 QX	2.00
Colo. Fuel & Iron	New York	76½	72	73½		
Colorado F. & I., pfd.	New York			133	Fe.11, Fe.25 Q	2.00
Great Northern Iron	New York	35	31½	33½	Dec.15, K	2.00
Inland Steel	New York	96	91	96	Fe. 15, Mr. 1, Q	0.87½
Republic I. & S.	New York	98½	92	97½	Fe. 13, Mr. 1, Q	1.00
Republic I. & S., pfd.	New York			115½	Mr.11, Ap. 1, Q	1.75
Sloss-Sheffield S. & I.	New York	118	115	118	Mr. 11, Mr.20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York			108	Mr.20, Ap.1, Q	1.75
U. S. Steel	New York	190½	180½	188	Fe. 28, Mr. 30, Q	1.75
U. S. Steel, pfd.	New York	143½	143½	143½	Fe 2, Fe. 27, Q	1.75
Virginia I. C. & C.	New York			25	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York			45	Jl.16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	169½	168½	169½		
Alum.Co.of Amer., pf.	N. Y. Curb	107	105½	107	Mr.15, Ap.1, Q	1.50
American Metal	New York	70½	63½	68½	Fe.9, Mr.1 Q	0.75
Amer. Metal, pfd., 6%	New York	121	119½	121	Fe.9, Mr.1, Q	1.50
Amer. Sm. & Ref.	New York	118½	112½	118½		
Amer. Sm. & Ref., pfd.	New York	135½	135½	135½	Fe. 1, Mr. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	43	38	43		
Asbestos Corp.	Montreal	16	15	15½	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	51½	50	51½	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	485	460	460	De.31,Ja.15,SA	X 6.25
De Beers Consol.	New York	22½	22½	22½	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	39	37½	37½		
Freeport Texas	New York	47	45½	47	Ja. 15, Fe. 1 Q	1.00
Int. Nickel Can., new	New York	62½	58	60	Mr.16, Mr.30 Q	0.20
Int. Nickel, pfd.	New York	128	124	128	Ja. 18, Fe. 1 Q	1.75
Newmont	N. Y. Curb	228½	221½	227	De. 28, Ja. 15 Q	1.00
Patiño M. & E.	New York	45½	42½	44	Aug. 1928	4s.
So. America G. & P.	N. Y. Curb	3½	3	3		
Texas Gulf Sulphur	New York	75½	72½	75	Mr.4, Mr.15 Q	1.00
U. S. Sm. R. & M.	New York	57½	65½	66½	De. 31, Ja. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	55½	55	55	De. 31, Ja. 15 Q	0.87½
Vanadium Corp.	New York	108½	102½	106	Fe.1, Fe.15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Spokane Stock Exchange, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED MARCH 5, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	18/9	18/9	18/9		
Alaska Treadwell (25)	71/3	68/9	70/—	Nov., 1926	4 (d)
Armayo Mines (25 frs.)	69/6	66/10½	68/9	Feb. 1929	5 (e)
Burma Corp (10 rupees)	17/9	17/1½	17/4½	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	21/9	20/4½	20/9		
Camp Bird (2s)	3/—	2/9	2/10½	April, 1928	16¾
El Oro (£1)	5/1½	4/7½	5/—	Nov., 1924	2½*
Frontino & Bolivia (£)	9/—	8/7½	8/9	Jan., 1929	3½
International Nickel of Canada (no par value)	$68½	$62½	$65	Mar., 1929	20(c)
Mexican Corpn. (£1)	11/4½	10/7½	11/—		
Mexican Mines of El Oro (£1)	11/10½	7/6	10/—	Dec., 1926	3½*
Mount Isa (£)	42/6	40/6	41/3		
N'Changa Copper Mining. (£1)	91/3	78/9	80/—		
Oroville Dredging (4s)	2/9	2/6	2/9	Nov., 1928	31½
Rhodesian Congo Border (£1)	121/3	101/3	110/—		
St. John del Rey (£1)	15/6	13/9	14/3	Dec., 1928	2½
San Francisco Mines (10s)	35/1½	34/3	34/9	Jan., 1929	25
Santa Gertrudis (£1)	11/1½	10/1½	10/6	Jan, 1929	7½
Selukwe (2s. 6d.)	7/4½	6/6	7/—	April, 1917	6½
S. Amer. Copper (2s.)	3/6	2/10½	3/3	Nov. 1917	75
Tanganyika (£1)	72/6	68/1½	71/10½	July, 1928	5
Union Miniere de Haut-Katanga (Brussels)	12,700	12,250	12,700	July, 1928	182.60‡

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.

(Price quoted in dollars with a fixed rate of $5 to the £1)